# SOIL SURVEY OF ANTELOPE COUNTY, NEBRASKA.

By F. A. HAYES, of the U. S. Department of Agriculture, in Charge, and H. C. MORTLOCK, M. H. LAYTON, H. E. WEAKLEY, and J. D. WESTERMAN, of the Nebraska Soil Survey.

## DESCRIPTION OF THE AREA.

Antelope County is situated in the northeastern part of Nebraska, about 90 miles west of Sioux City, Iowa. The county comprises an area of 864 square miles, or 552,960 acres.

The greater part of the county lies within the loess hill region of northeastern Nebraska and has the topography common to that region. It is, however, near the western edge of this division and includes parts of the sand-hill and high-plains regions.

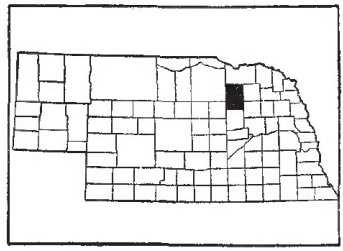

FIG. 28.—Sketch map showing location of the Antelope County area, Nebraska.

Stream erosion and wind action have been the principal agencies in the formation of the present topographic features of Antelope County. The surface was originally covered with a thick mantle of plains loess. Subsequent erosion and wind action have cut through and removed most of the loessial material, so that the surface now lies considerably below the original constructional plain. The topography varies from gently rolling to hilly, except where cut by broad, flat terraces and flood plains along the Elkhorn River and the narrow alluvial lands along the smaller streams. The county may, therefore, be separated into two main topographic divisions, the uplands and the alluvial lands.

The upland of Antelope County may be divided into three distinct belts extending in a northeast-southwest direction. In the southeastern part of the county there is an extensive area of eroded loess plain cut through by the valley of the Elkhorn River. This is a remnant of the original loess plain, which has been so modified by erosion that only a few of the broader divides remain to mark the level of the former loess mantle. The topography varies from almost flat to sharply rolling, modified in places by narrow strips of alluvial land along the larger creeks and drainage ways. The slopes to the larger streams are gradual, and the valleys are broad and rather deep. In a few places, however, the slopes are rather steep and marked by small landslides, so that they present a succession of contour shelves known as "catsteps." The channels of the numerous small drainage ways are narrow and in places steep sided, becoming gradually broader in their lower courses. The tops of the ridges usually are broad or well rounded and constitute small areas of even topography.

The rest of the upland, with the exception of a small area in the extreme northwest corner, is a broad belt of slightly lower lying upland, the surface of which has been modified largely by wind. The loessial material over most of this area appears to be entirely removed, with the exception of small isolated hills and ridges, and the underlying sand sheet exposed. Wind action has been the predominant factor in forming the surface relief. The topography is for the most part gently rolling to hummocky, but modified by numerous flats or depressions and extensive areas of sand hills.

The upland belt in the extreme northwest corner of the county comprises an area of about two townships. This belt represents a tongue of the original high plains which occupy the greater part of western Nebraska. It lies at approximately the same elevation as the eroded loess plain in the southeastern part of the county and from 50 to 75 feet above the broad belt in the central part. The topography of this high-plains belt ranges from extremely rough and broken to almost flat in places. The greater part has a sharply rolling relief. In the rougher areas the streams are deeply intrenched, the slopes steep, and the divides narrow. Rock cliffs form a prominent feature of the landscape. Within the larger stream valleys, where erosion has been less severe, the topography is flat to rolling.

The alluvial lands of Antelope County consist of the high terraces, the low terraces, and the first bottoms or flood plains. The largest developments occur along the Elkhorn River and extend across the county in a southeast-northwest direction, as a belt varying in width from about one-half mile to 3 miles. Smaller developments are found along most of the larger drainage ways throughout the county.

The high terraces occur only along the north side of the Elkhorn River, northeast of Oakdale, north of Neligh, north of Tilden, and northeast of Clearwater. The high terraces have a combined area of approximately 6 square miles. They lie from 20 to 25 feet above the low terraces and from 35 to 40 feet above the stream channel. The surface is flat, modified by slight depressions where crossed by drainage ways. The slopes leading from the high terraces to the upland are usually long and rather steep.

The low terraces occur along all the larger streams of the county, but are best developed along the Elkhorn River. They have a flat surface and lie from 8 to 10 feet above the first bottoms. The slopes bordering both the flood plains and high terraces are short and rather abrupt, although in places the low benches merge gradually into the bottom lands. Along the smaller drainage ways and along those parts of the Elkhorn River where the high terraces are not developed, the slopes leading from the upland to the low benches in most places are long and gradual.

The bottom lands of Antelope County are extensive along the Elkhorn River and the larger drainage ways. Along the river they vary in width from one-fourth to 1½ miles. Along the creeks and branches they are seldom wider than one-half mile, except along Willow Creek, in the east-central part of the county, where a width of 3½ miles is attained in a few places. The flood plains lie from 3 to 5 feet above the stream channels. They have a comparatively level, flat topography, modified in places by cut-offs, shallow depressions, and low rounded hummocks of wind-blown sand.

The elevation of the alluvial land in the vicinity of Clearwater in the west-central part of the county, is 1,793 feet above sea level, and in the vicinity of Tilden, 1,679 feet. The elevation of Brunswick is 1,859 feet, Orchard 1,945 feet, Neligh 1,746 feet, Elgin 1,929 feet, and Oakdale 1,710 feet.[1] It is estimated that the eroded loess plain lies 200 to 250 feet above the first bottoms, and that the total range of elevation in the county is probably not over 300 feet. Along the northern boundary the land slopes to the north. Throughout the rest of the county there is a gradual slope to the east.

With the exception of the northern tier of townships, the entire county is drained by the Elkhorn River and its tributaries. The river follows a meandering southeasterly course across the central part of the county. It has a fall of 7 feet per mile. The main channel varies in width from 75 to 100 feet. It is extremely shallow and subject to overflow and shifting during periods of heavy rainfall, when considerable damage is done to crops and property.

The largest tributaries on the south side of the river are Clearwater, Antelope, Cedar, St. Clair, Ives, and Giles Creeks, all of which are permanent streams and enter the river within the county. The tributaries on the north side of the Elkhorn River are all intermittent, with the exception of Willow Creek. This creek drains a small area in the east-central part of the county and empties into the North Fork Elkhorn River in Madison County.

A small area along the northern border of the county is drained northward through the branches of Verdigris Creek and Bazile Creek into the Niobrara and Missouri Rivers.

The river, creeks, and intermittent drainage ways afford ample drainage for most of the county. All sections of the eroded loess plains in the southeast part of the county are well drained. Surface drainage is not well established in the sandy upland belt throughout the southwestern and north central parts of the county. Water seldom accumulates on the surface, however, as the porous nature of the sand sheet affords ample underdrainage. The most poorly drained areas in the county are in local depressions throughout the sandy upland belt, and in the first bottoms along the Elkhorn River and Willow Creek. Many of the smaller upland drainage ways have partly filled their channels with sediment where they issue into the lowland, and the water spreads out before it reaches the main stream. The larger creeks are intrenched in their flood plains and overflow only during abnormal seasons.

Well water of excellent quality is readily obtained in all parts of the county. On the eroded loess plain the wells range in depth from 60 to 125 feet. Throughout the sandy upland good water is available at depths of 50 to 90 feet. In the northwestern corner the wells of the upland range in depth from 50 to 100 feet. In the bottom lands the wells are much shallower, and water for stock is often obtained at depths ranging from 10 to 30 feet.

Native forest grows in narrow belts along all the larger streams. It consists chiefly of elm, ash, boxelder, willow, and cottonwood interspersed with some oak and hackberry. None of the timber is of

[1] Gannett, Dictionary of Altitudes. Bul. 6, U. S. G. S.

merchantable size, but is of value for firewood and fence posts. Groves of cottonwood, ranging in size from one-half acre to 5 acres, have been planted on many farms.

The first permanent settlement in Antelope County was made in November, 1868. In 1870 a settlement was made on Cedar Creek about 7 miles from Oakdale. Within the next few years most of the land had been filed on under the public land laws. The early settlers were of many nationalities, but a large proportion was American born.

Antelope County was organized by the State legislature in 1871. Its boundaries have remained unchanged.

The population of the county is all classed as rural, as there are no towns exceeding 2,500 inhabitants. According to the Federal census the population increased from 10,399 in 1890 to 15,243 in 1920. The greatest increase during these three decades took place between 1900 and 1910. The density of the population is given as 17.5 persons per square mile. It is rather unevenly distributed, being densest in the immediate vicinity of the various towns and upon the eroded loess plains in the southeastern part of the county. The most sparsely settled regions include the sandier parts of the upland and the rougher sections of the high plains in the northwest corner.

In 1920, 65.5 per cent of the inhabitants were native white persons of native parentage, 26.8 per cent were native whites of foreign or mixed parentage, and 7.7 per cent were of foreign birth.

Neligh, the county seat and largest town, with a population of 1,724 in 1920, is located in the Elkhorn Valley and is an important distributing center for farm implements and supplies. Tilden has a population of 1,101. It lies on the south side of the Elkhorn River, and part of it is in Madison County. Elgin has a population of 854. Oakdale, with 707 inhabitants, is an important milling center, the water power being developed on Cedar Creek. Other towns include Clearwater, with a population of 479, Orchard, with 444 inhabitants, Brunswick, with 359, and Royal, with 202.

Antelope County has fair transportation facilities. The main line of the Chicago & North Western Railway from Omaha to Chadron follows the Elkhorn Valley across the county. Tilden, Oakdale, Neligh, and Clearwater are on this line. A branch of this road extends southward from Oakdale, through Elgin, to Albion in Boone County. A branch of the Chicago, Burlington & Quincy Railroad from Sioux City, Iowa, to O'Neill, Nebr., traverses the northern part of the county from east to west, passing through Copenhagen, Brunswick, Royal, and Orchard.

The county is well supplied with public roads. The highways follow section lines, except in the rougher and more sandy districts, where the expense of construction and maintenance is excessive. All are earth roads. The more important ones, including the State and Federal-aid highways, are well graded, surfaced where necessary, and kept in good repair throughout the year. The minor roads are frequently neglected and are sometimes impassable. Increased attention is being given to the construction of concrete culverts and steel bridges.

All parts of the county have rural mail delivery, and telephones are in common use.

Most of the surplus agricultural products are shipped to Omaha and Sioux City. The surplus wheat and corn is usually hauled to local elevators, where it is either sold or stored until the market is favorable. Considerable wheat is ground in the flour mills at Neligh and Oakdale.

## CLIMATE.

The climate of Antelope County is typical of northeastern Nebraska and is well suited to grain farming and stock raising. The long, warm summers are especially favorable for corn. The occasional low temperatures of winter are not usually destructive to winter-grown crops, owing to the protection of snow. The spring is usually cool, with considerable rainy weather, and the autumns long and pleasant, with only occasional periods of rainy weather. There is not enough variation in surface relief to cause any appreciable differences in climate within the county.

The table below, compiled from the records of the Weather Bureau station at Oakdale, in the southeastern part of the county, gives the normal monthly, seasonal, and annual temperature and precipitation:

*Normal monthy, seasonal, and annual temperature and precipitation at Oakdale.*

(Elevation, 1,722 feet.)

| Month. | Temperature. | | | Precipitation. | | |
|---|---|---|---|---|---|---|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year (1894). | Total amount for the wettest year (1920). |
| | °F. | °F. | °F. | Inches. | Inches. | Inches. |
| December | 23.7 | 68 | −29 | 0.75 | 0.87 | 0.75 |
| January | 18.5 | 64 | −40 | .48 | .49 | .05 |
| February | 20.0 | 74 | −33 | .77 | .30 | .29 |
| Winter | 20.7 | 74 | −40 | 2.00 | 1.66 | 1.09 |
| March | 32.7 | 88 | −23 | 1.05 | .58 | 3.21 |
| April | 47.8 | 101 | 13 | 2.82 | 2.57 | 8.04 |
| May | 58.3 | 98 | 20 | 3.89 | 1.13 | 3.68 |
| Spring | 46.3 | 101 | −23 | 7.76 | 4.28 | 14.93 |
| June | 68.4 | 106 | 36 | 4.28 | 1.14 | 6.21 |
| July | 73.5 | 110 | 38 | 3.46 | .78 | 6.73 |
| August | 71.2 | 105 | 34 | 2.90 | .92 | 4.32 |
| Summer | 71.0 | 110 | 34 | 10.64 | 2.84 | 17.26 |
| September | 62.3 | 102 | 20 | 2.34 | .89 | .68 |
| October | 49.4 | 90 | 4 | 1.67 | 1.75 | 3.18 |
| November | 34.6 | 78 | −15 | .71 | .10 | .91 |
| Fall | 48.8 | 102 | −15 | 4.72 | 2.74 | 4.77 |
| Year | 46.7 | 110 | −40 | 25.12 | 11.52 | 38.05 |

The mean annual temperature is 46.7° F. January is the coldest month, with a mean of 18.5° F., and July is the warmest, with a mean of 73.5° F. There is a range in temperature of 55° between the means of the coldest and warmest months. The absolute minimum temperature is −40° F., recorded in January, and the highest, 110° F., recorded in July.

The average date of the last killing frost in the spring is May 4, and that of the first in the fall, September 29. This gives an average growing season of 148 days, which is ample for the maturing of all farm crops common to the region. The latest recorded killing frost in the spring occurred on May 27 and the earliest in the fall on September 11. The grazing season begins about June 1 and ends in the latter part of October.

The mean annual precipitation is 25.12 inches. In average years more than half of this falls during the months of May, June, July, and August. The total precipitation in the driest year on record (1894) was 11.52 inches, and in the wettest year (1920) 38.05 inches. The driest months are November, December, January, and February, the mean annual precipitation of each being less than an inch.

In the summer the rainfall usually comes as heavy thundershowers. Torrential rains, however, are rare. Severe droughts are almost unknown during May and June, but in the latter part of July and through August the rainfall varies considerably and short dry spells may occur. Crops seldom suffer from lack of moisture, however, when proper cultural methods are followed, as most of the soils have a high water-holding capacity. Serious droughts are practically unknown. The amount of snowfall varies annually from a few inches to several feet.

From October 1 to April 1 the prevailing wind is from the northwest and from April 1 to October 1 it is from a southern direction. Strong winds are common, but tornadoes are rare.

## AGRICULTURE.

The first permanent settlements in Antelope County were established in 1868, 1869, and 1870, along the edges of the first bottoms, where there was an abundance of fuel and water. One of the early settlements was made on Cedar Creek, about 7 miles from the present town of Oakdale. Cattle raising was practiced extensively during the early development of the county, and many large tracts were included in ranches on which beef cattle were grazed. The more sandy areas are still used for ranching.

The first cultivated crops consisted of sod corn and garden vegetables, followed by corn, oats, and wheat as conditions became more stable. Corn has always been the leading grain crop. Wheat was grown chiefly for sale. Most of the wheat was of the spring varieties. Flax, barley, and rye were also grown.

The early agriculture developed slowly owing to the ravages of insect pests, the absence of transportation facilities and markets, and the lack of attention given to proper cultivation of crops, seed selection, and rotation. The early settlers had little capital to tide them over years of crop failures, and after the "grasshopper" year of 1874, when crops were destroyed over large areas, the settlers were slow in recovering. The extension of the Chicago & North Western Railway into Oakdale in 1879 gave the first marked impetus to the agricultural development of Antelope County.

The census reports give the value per farm of all farm property, including land, buildings, implements, and domestic animals, at $1,801 in 1880, $3,699 in 1890, $5,622 in 1900, $15,257 in 1910, and $33,312 in 1920. Between 1880 and 1920 the number of farms increased from

465 to 2,083. The average size of the farms shows considerable fluctuation between 1880 and 1920. It was greatest in 1900, when it was reported as 269.8 acres. The percentage of the county in farms was 14.5 in 1880, 58.0 in 1890, 84.4 in 1900, 88.6 in 1910, and 92.9 in 1920.

The following table, compiled from the census reports, gives the acreage and production of the principal crops of the county in 1889, 1899, 1909, and 1919, and shows the general trend of agriculture during the last 30 years:

*Acreage and production of principal crops in 1889, 1899, 1909, and 1919.*

| Crop. | 1889. | | 1899. | | 1909. | | 1919. | |
|---|---|---|---|---|---|---|---|---|
| | *Acres.* | *Bushels.* | *Acres.* | *Bushels.* | *Acres.* | *Bushels.* | *Acres.* | *Bushels.* |
| Corn | 90,797 | 2,477,646 | 113,542 | 3,131,390 | 140,896 | 4,610,994 | 140,884 | 3,684,187 |
| Oats | 22,286 | 587,923 | 32,203 | 913,080 | 65,031 | 1,182,879 | 42,354 | 1,080,234 |
| Wheat | 9,171 | 104,954 | 38,610 | 443,650 | 9,512 | 146,777 | 21,037 | 173,033 |
| Rye | 1,615 | 19,400 | 5,826 | 66,080 | 3,415 | 33,469 | 25,521 | 209,993 |
| Barley | 469 | 7,660 | 1,338 | 28,210 | 269 | 4,790 | 1,163 | 22,601 |
| Emmer and spelt | | | | | 266 | 4,798 | 177 | 3,661 |
| Buckwheat | 1,591 | 8,648 | 102 | 1,000 | 72 | 638 | | |
| Potatoes | 1,177 | 101,488 | 1,039 | 101,769 | 1,095 | 80,665 | 1,172 | 59,693 |
| | | *Tons.* | | *Tons.* | | *Tons.* | | *Tons.* |
| Wild hay | 40,182 | 47,618 | 56,681 | 55,195 | 61,812 | 60,669 | 50,496 | 37,312 |
| Alfalfa | | | 483 | 1,270 | 9,558 | 24,917 | 23,008 | 43,741 |
| Timothy and clover mixed | | | | | 3,961 | 6,492 | 1,519 | 2,163 |
| Millet and other tame grasses | | | 3,523 | 6,184 | 2,591 | 4,181 | 2,651 | 3,678 |
| Coarse forage[1] | | | 125 | 428 | 1,321 | 4,334 | 7,014 | 13,807 |
| | *Trees.* | *Bushels.* | *Trees.* | *Bushels.* | *Trees.* | *Bushels.* | *Trees.* | *Bushels.* |
| Apples | 3,261 | 882 | 36,019 | 4,393 | 29,246 | 56,228 | 26,159 | 17,862 |
| Cherries | | | | | 10,628 | 3,212 | 4,537 | 1,130 |

[1] Coarse forage includes corn and kafir and other sorghums.

At present the agriculture of Antelope County consists of a combined system of grain growing and stock ranching. The eroded loess plains belt in the southeastern part is used chiefly for grain production, only the rougher land being in pasture. The sandy upland belt, comprising the greater part of the area, is used largely for the grazing of beef cattle and the production of native hay, although grain crops are grown in the more favorably located sections. The rougher parts of the high-plains belt, in the extreme northwest corner of the county, are used exclusively for pasture and cultivated crops are grown on the more level areas. Approximately half of the entire county is under cultivation.

Corn has by far the largest acreage; it occupies more than half of the land devoted to cultivated crops. Most of the corn is fed to hogs, beef cattle, work stock, and dairy animals. Especially is this true on farms operated by owners. On the tenant farms, where little livestock is kept, the corn constitutes the chief cash crop. It is common practice to husk the corn from the standing stalks in the fall and pasture cattle and horses in the fields during the winter. A part of the crop is cut for winter roughage. On farms equipped with silos from 15 to 20 acres of corn are cut each year for silage. The corn for silage is usually cut with a corn binder when the ears are in the "dough" stage, and hauled to the silage cutter while the stalks are still green.

The silos range in capacity from 80 to 200 tons. Many farmers fence off a few acres of unhusked corn for hog range.

On some farms corn is grown on the same land 5 or 6 years consecutively. Much better yields are obtained, however, where it is grown in rotation with small grains and alfalfa. In recent years some attention has been given to the improvement of the seed corn, but as a rule seed selection is not carefully practiced. The chief varieties of corn are Reid Yellow Dent, Nebraska White Prize, and Iowa Silvermine. The crop is raised on all the soils of the county except the poorly drained parts of the flood plains and the roughest and most sandy areas of the uplands. The Marshall soils in the southeastern part of the county and the Waukesha and Wabash soils of the alluvial lands produce the higher yields.

Oats generally occupy the second largest acreage. The average yield in 1919 was about 24 bushels per acre. This yield, however, is often greatly exceeded, and during exceptional seasons yields as high as 99 bushels per acre have been reported. The crop is grown on all the improved soils of the county. It is not so well adapted to the sandier soils as corn on account of its shallower root system and the danger of injury to the young plants by drifting soils. The crop is frequently used as a step in the rotation between corn and wheat, rye, or barley. It is seldom grown twice in succession on the same land. Texas Rust Proof and Kherson are the leading varieties. The latter has a short, stiff stem and is well adapted to the bottomland soils on which the crop is likely to lodge. Some seed is imported from other sections, but more commonly the seed is obtained by cleaning part of the previous crop. Little effort is made to control smut, although the disease often lowers crop yields during seasons of excessive precipitation or prolonged periods of cloudy weather. The grain is usually cut with a binder and either shocked or stacked for threshing. It is used chiefly as feed for work stock, although some is sold. The straw is used for roughage, stock being allowed to feed around the stack. A little of the straw is baled and shipped.

Rye ranks next to oats among the grain crops. Rye is adapted to a greater variety of soils than the other grain crops and is grown upon all the soils of the county except Dunesand and the more poorly drained bottom land. It is generally raised for the grain, but to some extent for hay and pasture. It is more drought resistant than wheat and will flourish on soils of a more impoverished nature. Much of the crop is raised upon the sandier soils of the Marshall series and upon the Valentine loamy sand. In cutting the crop either a binder or header is used, depending upon the length of the straw. The grain is threshed from shocks or from stacks, the latter method being invariably used for headed rye. Most of the rye is fed locally to hogs, although some is shipped to outside markets.

Wheat is not grown very extensively in Antelope County, chiefly on account of the sandy nature of the greater part of the soils. In 1921 only 3,370 acres were devoted to this crop. Both winter and spring wheat are raised, but winter wheat occupies about three-fourths of the total acreage. The average yield of winter wheat is reported as 13 bushels per acre and that of spring wheat as 10 bushels. Much higher yields are obtained upon the Marshall silt loam and the Waukesha silt loam, where 20 to 25 bushels are common under good

management. Winter wheat produces higher and more uniform yields than spring wheat, can be sown in the fall at a time when farm work is light, and matures before the dry weather and hot winds occur. Though there is some danger of winterkilling, this has been considerably reduced since the Turkey, a very hardy winter wheat, was introduced. Several varieties of spring wheat are grown, but little effort is made to keep the strains pure. Smut causes some damage to both winter and spring wheats. Rust rarely injures winter wheat, but is very destructive to the spring crop. The yields of both kinds are sometimes reduced by the Hessian fly.

Wheat is usually cut with a binder, except that in exceptionally dry seasons, when the straw is too short for binding, the grain is headed. The crop is shocked or stacked in the field for threshing. Most of the grain is sold direct from the threshing machine, although some is stored in local bins and elevators until the market is satisfactory. The straw is left in the field and stock is allowed to feed upon the stack.

Wild hay is still an important crop in Antelope County, as large areas in the more sandy and rougher upland sections and in the more poorly drained bottom lands are unsuited to grain production. Much hay is grown on the coarser Valentine soils on account of the danger of soil drifting when the protective sod is destroyed. Only the rougher parts of the loessial uplands remain in wild grasses. The average yield in recent years has been somewhat less than a ton per acre. The highest yields are obtained on the poorly drained alluvial soil. The quality, however, of the upland hay is much better, since it grows less rank, is of finer texture, and has a higher feeding value. The hay is stacked in the field and either baled for market or hauled to the feed lots as needed.

Alfalfa has become a very important crop in the last 20 years and now ranks next to wild hay in acreage among the forage crops. Alfalfa does well on all soils in the county except the more sandy upland soils where the lime content is insufficient for best results and the more poorly drained bottom soils, in which the water table lies too near the surface. It is exceptionally well adapted to the soils of the Knox series on account of their high lime content. The crop is also beneficial to these soils in that it prevents erosion and increases the naturally low content of organic matter. The seed is usually sown in August after the first good rain, at the rate of 12 to 15 pounds per acre. Occasionally a nurse crop of wheat or oats is sown with the alfalfa. The stand is left from six to eight years. A field of alfalfa is rarely frozen out. The main consideration in obtaining a stand is thorough preparation of the seed bed.

The alfalfa is usually cut three times during the summer season; occasionally a fourth cutting is obtained. Yields range from 2 to 4½ tons per season, depending upon the soil and moisture conditions. Alfalfa is stacked in the field, is hauled to the feed lots as needed, and is fed to cattle and hogs. On many farms hogs run in the fields during the summer. Cattle, however, are seldom allowed to graze on green alfalfa on account of the danger of bloating. The crop not only has a high nutritive value and yields well, but is valuable in increasing the productive power of the soil for grain crops, particularly

corn and oats. It is equal to red clover in this respect, although less suited to short rotations.

In 1921 sweet clover was grown on 1,468 acres in Antelope County. This crop makes good pasture for cattle and sheep, as it is less likely to cause bloat than alfalfa. To make good pasture the plant should be grazed close enough to prevent coarse growth, especially the second year. The permanence of a sweet-clover pasture depends entirely upon its ability to reseed, because the plants die at the end of the second year. Therefore, care must be taken not to graze the plant so closely after the first year that an insufficient quantity of seed will mature to reseed the following year. Seeding during two consecutive years at the start has been recommended to provide for annual reseeding and also for continuous late and early pasture. Sweet clover has an unusually wide adaptation. It thrives on both relatively wet and dry soils, and on sandy and clayey soils. It is better suited to the soils of the Valentine series than alfalfa on account of its lower lime requirement.

Mixed stands of timothy and clover are grown to some extent upon the bottom lands along the Elkhorn River. Most of the timothy and clover is cut for hay, which is fed to work stock and cattle. Very little of the crop is pastured. It is well adapted to the moist soils of the bottom lands, where the uncertain drainage conditions prohibit the raising of grain crops.

Of the minor crops, potatoes, millet, barley, and emmer are important. These crops occupy a variable acreage and yield well in normal years. Sorghum, kafir, flax, and beans are produced on a few farms.

Trucking receives but little attention, owing to the distance from large markets. Some vegetables are grown for sale near the larger towns and villages. Watermelons and muskmelons are raised locally upon the sandy terrace and bottom soils along the Elkhorn River.

A few small apple orchards occur throughout the county. The demand for fruit is not supplied, and it would seem that its production, especially upon the terrace soils, could be profitably extended. Trees usually do not do so well upon the upland on account of lack of moisture, which is largely offset on the terrace lands by the nearness of the water table to the surface. Plums, cherries, grapes, strawberries, and other small fruits are also grown. Of the wild fruits, plums and grapes are most important; they grow chiefly along the Elkhorn River and the larger creeks throughout the county.

As a source of income the livestock industry of Antelope County holds a prominent place. Much of the county is used as grazing land, and the raising of beef cattle is very important. The Federal census reports 47,708 cattle, valued at $2,708,957, in the county in January, 1920. There are only a few purebred herds, though many purebred bulls have been introduced in recent years to improve the grade stock. The quality of the beef cattle in general is very good. Grade Hereford and Shorthorn are the principal breeds. Some of the native cattle are fed for market, but large numbers are sold as stockers and feeders after coming off summer range. A few farmers annually ship in cattle for winter feeding and many ranchers purchase stock for summer grazing.

Dairying receives but little attention. There are a few purebred Holstein herds in the county, but the dairy industry is confined largely to the sale of surplus cream and butter. From six to eight milk cows, mainly of beef breeds, are kept on the average farm. Many farmers have cream separators. The surplus dairy products are sold in the near-by towns. Part of the cream is shipped to Fremont, Lincoln, and Omaha. The value of dairy products in 1919 is reported as $429,128.

Hog raising is an important branch of the livestock industry. The 1920 Federal census reports 80,005 hogs, with a total value of $1,728,861, in Antelope County. Most of the hogs are raised in the southeastern part, where the heavier terrace and upland soils produce an abundance of alfalfa and corn. Hog raising is of minor importance on the sandier soils, as these areas are better suited for grazing of cattle than for grain production. All of the hogs are of good breeding, and there are several purebred herds in the county. Duroc-Jersey, Spotted Poland-China, and Hampshire are the leading breeds. The Poland-Chinas are raised chiefly in the northern part, in the vicinity of Brunswick. At times heavy losses are caused by hog cholera. Attention is being given, however, to vaccination and sanitary measures, and the losses in recent years have been greatly reduced.

Sheep raising does not receive much attention. A few flocks are grazed in the rougher sections of the southeastern part and the hilly areas of the northwestern part. Very few sheep are raised in the sandy parts of the county. The census reports 7,538 sheep in the county, with a total value of $78,062, in 1920. Some farmers buy a carload or two in the fall, fatten them on corn and alfalfa, and sell them when the prices are satisfactory. The favorable climatic conditions and the abundance of feed would seem to warrant an extension of the sheep-raising industry. Large numbers could be fattened in the cornfields in the fall at a minimum of expenditure for feed.

Horse raising is confined largely to the breeding of work mares. Most farmers raise two or three colts each year, and often a team is sold. Much improvement has been made in the stock during recent years, following the introduction of purebred stallions. At present the animals are all of heavy draft types, the Percheron being the chief breed. A few mules are raised. According to the census there were 14,607 horses, valued at $1,190,166, and 1,046 mules, valued at $126,191, in the county in 1920.

Poultry constitutes an important source of farm income. A few chickens are raised on all farms, and on many farms the flocks are large. There is usually a good local demand for poultry products, and the poultry industry is receiving increased attention. The Leghorn, Plymouth Rock, Rhode Island Red, and Orpington are the principal breeds. Ducks, geese, turkeys, and guinea fowls are raised to a small extent. The Federal census reports 181,453 chickens and 4,505 other poultry in the county in 1920. The value of chickens and eggs produced in 1919 is given as $400,959.

The adaptation of certain soils to particular crops is observed to some extent by farmers. It is recognized that alfalfa is not suited to the sandy Valentine soils on account of their low lime content and unstable nature, but is well suited to all the soils of the Marshall, Knox, Waukesha, and Wabash series. It does especially well on the

Knox silt loam, which has a high lime content. The highest yields are produced on the terraces and better-drained bottom soils.

Corn is known to thrive better upon the sandy soils than small-grain crops, on account of its deeper rooting system. The highest yields, however, are obtained on the heavier and finer textured upland, terrace, and flood-plain soils. Small grains do best upon the Marshall and Waukesha silt loams. The sandy Cass soils of the bottom lands are better adapted to truck crops than the heavier upland soils, as they warm up earlier in the spring and have a more favorable moisture supply. Dunesand, the more sandy members of the Valentine series, and the more hilly and eroded hard-land soils are best suited for grazing and hay production. While the above crop adaptations are recognized, there is not sufficient variation in yields to cause specialized farming in any part of the county, except on Dunesand areas, where cattle grazing is practiced almost exclusively.

More attention is being given to careful preparation of the seed beds and the subsequent care of the crops. In the more sandy sections corn is usually listed in, the single-row lister being commonly used. Listed corn is thought to withstand drought better than surface-planted corn. The ridges also tend to prevent soil blowing. In the southeastern part of the county, where the soil is heavy and more compact and stable, much of the corn is planted in check rows. This method requires more careful seed-bed preparation and is conducive to higher yields. On the more rolling land listed corn is subject to severe washing in seasons of heavy rainfall, and on the steeper slopes entire rows are sometimes washed out.

The preparation of the seed bed for small grain varies somewhat according to the soil. The heavier textured soils are plowed from 4 to 6 inches deep before planting. The more sandy soils are plowed only every second or third year, and during the intervening years the land is prepared by double-disking. All small grain is planted with a press drill. In preparing old corn or stubble ground for small grain, the tenant farmers plow even the heavier textured soils only every second or third year, and disk the land thoroughly before planting. Sometimes wheat is sown between the corn rows in the fall.

Alfalfa is sown on a well-prepared seed bed in the late fall or early spring, sometimes with a nurse crop of wheat or oats. Usually it is sown broadcast and harrowed in, although a few farmers prefer to sow with a press drill to obtain a more even stand. A stand is easily obtained, except on the sandier soils, which are low in lime. Barnyard manure is very beneficial to this crop.

Potatoes are usually planted in plow furrows. The cuttings are dropped by hand about 2 feet apart, in every third furrow slice. Potato beetles are very injurious to the crop, and it is often necessary to spray the vines with poisons to control the insects.

As a rule, the farms are well improved and have a general appearance of prosperity. The houses and barns are usually painted and kept in good repair. The farms are fenced and cross-fenced, mostly with barbed wire, though many farms are inclosed with hog-tight woven-wire fencing. The farms operated by owners are usually kept in somewhat better repair than those occupied by tenants. The work stock on all farms consists of medium to heavy draft horses and mules. A few tractors are operated on the more level sections,

but are not in common use throughout the county. Most farms have an adequate supply of modern labor-saving machinery, including grain drills, mowers, rakes, binders, riding cultivators, disk harrows, and manure spreaders. Corn binders and hay balers are in use on a few farms. There are enough threshing machines in the county to handle the grain crops. Most of these are owned by farmers who thresh the grain for the surrounding community. Only the more expensive farm machinery is kept under shelter.

Corn is usually cultivated three or four times in a season. A two-row cultivator is commonly used. Many farmers harrow the ground a number of times before the young plants are large enough to cultivate, in order to keep down the weeds and conserve the soil moisture. Potatoes are usually cultivated about five times, usually with a single-row cultivator.

There is no definite system of crop rotation in Antelope County, although most farmers change their crops with sufficient regularity to prevent the soil from becoming impoverished. When alfalfa sod is broken the land is usually used for corn two years, oats one year, then wheat or rye, and back to corn. While corn is probably better adapted to alfalfa ground than small grain on account of its deeper rooting system, even corn is subject to drought during dry seasons, as the alfalfa plant requires considerable moisture and leaves the ground in a comparatively dry condition. Corn is often grown on the same land from two to four years. Alfalfa does not adapt itself well to short rotations, and most farmers prefer to keep the stand for five or six years.

No commercial fertilizer is used. The barnyard manure is piled on the ground out of doors, where much of its fertilizing value is lost by leaching. The manure is hauled in the fall or spring and generally broadcasted on land to be used for corn or small grain. It is often applied to the more eroded or more sandy parts of the field to increase the organic content or retard wind erosion. On rented farms little care is used in applying the manure where it is most needed, most of it being spread on the land adjacent to the barnyard.

Farm laborers are not easily obtained, especially during busy seasons. Wages range from $40 to $60 per month. Those laborers receiving the higher wages usually board themselves, although they are furnished a house to live in. Day labor commands $2.50 to $3 a day, and during harvest from $5 to $6 was paid in 1921. Corn shuckers receive 3 to 4 cents per bushel. Wheat is threshed for 7 cents per bushel and oats for 3 to 4 cents, depending upon whether it is shocked or stacked. Many farmers hire help by the year in order to insure against an inadequate supply at critical periods.

The Federal census reports that 92.9 per cent of the county was included in 2,083 farms in 1920. The average size of the farms was 248.9 acres. The size usually ranges between 80 and 320 acres, although there are many small holdings and a few large ranches of over 1,000 acres. Nearly 79 per cent of the farm land is improved.

Owners operated 1,150 farms and tenants 899 farms in 1920. The proportion of tenant farmers has been gradually increasing since the county was established. Both the share and cash rental systems, as well as a combination of the two, are practiced. Under the share

system, which is the most popular, the tenant usually receives three-fifths of the grain, and furnishes all seed, labor, and machinery. Under the cash system the renter usually pays $5 an acre for the use of the land, including the pasture. Farms suited only for pasture are often rented for a lump sum. On a few farms the tenant has the use of the pasture land without charge. During the last few years very little of the land suited to grain production has been rented for cash.

The 1920 census reports the average assessed value of all the land in farms in Antelope County to be $103.02 an acre. The price of land ranges from about $35 to $275 or $300 an acre, depending upon the soil, topography, drainage, improvements, and location with respect to markets. The highest priced land, regardless of quality, is that in the immediate vicinity of the larger towns. The lowest price applies to areas of Dunesand and the badly eroded lands in the northwestern part of the county, which are suited only for grazing cattle. The average price of farms on the eroded loess plain in the southeastern part is about $150 an acre. The better soils of the sandy part of the county sell for $75 to $120 an acre, depending upon location and improvements. The heavier textured terrace soils have an average price of about $175. Bottom land sells for $40 to $200 an acre, depending largely upon location, drainage, and improvements.

## SOILS.

Antelope County, Nebr., lies in that belt of the United States where more than elsewhere the influence of climate is strongly impressed upon the soils. The most important characteristics of the soils of the region are a result directly or indirectly of climatic influences, particularly of those which determine the available supply of soil moisture. The parent materials on which these soils were developed differ widely in color, texture, and composition, but the soil-forming processes, acting through long periods of time, have produced soils having certain common characteristics. On the well-drained upland, where the soil-forming processes have acted with greater intensity, the most obvious and striking characteristic of the soils is the dark color. The available moisture supply of the region has not been sufficient to support a forest vegetation, but it is quite favorable to the growth of short grasses. These grasses are the source of the organic matter which imparts the black color to the surface soil.

The second common characteristic of the upland soils is the accumulation of carbonates, principally lime carbonate, in the lower subsoil. This high content of carbonate is a result of the low moisture supply, which, although sufficient to favor the accumulation of large amounts of humus from the decay of the grass roots, is not sufficient to leach the soil to any great depth. The carbonates, therefore, occur in only small quantities in the surface soil, but they are in such abundance below depths of 18 to 25 inches that an actual concentration is indicated. Other less noticeable or less prevalent characteristics which are a direct result of the soil-forming processes are discussed in subsequent pages of this report.

The soils of the well-drained upland, where undisturbed by erosion, have reached a stage of development that may be regarded as

mature for this climatic belt. The typical profile to a depth of 36 inches is characterized by three distinct horizons—a very dark grayish brown, almost black, finely granular surface soil, a more coarsely granular, heavier, brown upper subsoil, and a light-colored, friable, in places floury, lower subsoil. The two upper sections are not highly calcareous and very rarely effervesce with acid. The lower section, however, contains a very large percentage of lime and other carbonates, including not only the content of the original parent material of this horizon, but probably a concentration from above and below. Soils which have reached this stage of development on the upland are shown on the soil map which accompanies this report as soils of the Marshall and Holt series. The Sioux series includes well-drained porous soils which have a profile similar in some respects to that just described, but less perfectly developed on account of the porous nature of the subsoil, which has prevented the large accumulation of lime. The subsoil is calcareous, however, and in a broad classification belongs to this group.

Soils which have been readily leached by reason of their loose, porous character, have not developed the mature profile of this region. To this group belong the soils of the Valentine series and Dunesand.

Where erosion is active the dark-colored surface soil is removed as fast as it is formed. Considerable areas in this county have been eroded in this manner. The Knox series is representative of this group.

On terraces where leaching has been more thorough the lime has been largely removed within the 3-foot profile. This stage has been reached with the terrace soils of the Waukesha, O'Neill, and Plainfield series.

Soils which occur in areas of restricted drainage on the uplands, such as flats or shallow basins, have developed distinct profiles. The Gannett and Scott series have been developed in such positions under conditions of excessive moisture.

Three series of dark-colored soils occur in the low first bottoms. The differences in these soils are due to different conditions of drainage and the extent to which leaching has taken place. The Wabash soils are leached of their lime throughout the 3-foot profile, but the Lamoure types are highly calcareous. The Cass soils have light-textured subsoils and are moderately calcareous. The Sarpy sand and Riverwash are light-colored, recently deposited flood-plain materials which have not yet developed distinct profiles.

The groups of soils mentioned above have been differentiated into soil series on the basis of differences in structure and minor details of the soil profile, and on the basis of the sources, character, and process of accumulation of the material from which the soils have developed. The series are divided into soil types, which differ from each other in the texture of the surface soil.

Originally a silt or loess deposit covered the entire county, lying unconformably upon the underlying formations. Erosion has removed most of this mantle. The only extensive remnants are in the loess hills belt in the southeastern part of the area. Elsewhere its former presence is indicated by low isolated hills and rounded ridges scattered throughout the county, and by a thin veneer covering parts

of the upland in the extreme northwest corner of the area. In its original unweathered condition the loess consists of loosely consolidated material ranging in texture from silt loam to heavy silt loam. It varies in color from brownish yellow to yellow, light gray, or almost white. The material has a high lime content, and the presence of iron is locally indicated by rusty streaks and blotches. Since its deposition the process of soil formation has produced marked changes in the color, structure, and composition of the material where erosion has not been severe, and has resulted in the formation of the mature soil profile described above. In Antelope County the loessial soil having the characteristic mature profile is classed with the Marshall series.

In the more dissected parts of the eroded loess plain, erosion has retarded weathering and the accumulation of organic matter on the surface of the original deposit. The resultant soils are light in color and low in organic matter, and are composed of highly calcareous silt similar to that of the original deposit. These soils have been included with the Knox series.

Below the plains loess lies a layer of sand, the exact geological relationship of which is not clearly understood. It is thought to be composed largely of decayed granite and to represent débris carried down from regions to the north and west. It may be of late Tertiary age, but is generally regarded as being of early Pleistocene. This sand plain has been exposed over the greater part of the county. In its original condition it consists of light-brown to yellowish-gray fine sand composed largely of quartz. Locally the material contains considerable fine gravel. Extensive weathering and the accumulation of organic matter have given the surface material a brown to dark-brown color. Wind action has played an important part in the modification and transportation of the sand deposit, so that probably a very small proportion of the surface has remained undisturbed since the protective loess covering was removed. On the south side of the Elkhorn River there are extensive areas in which the wind has heaped the sand into dunes varying in height from 30 to 50 feet, and most of the accumulated organic matter has been blown away. Such areas have been classed as Dunesand. Elsewhere the surface of the original sand plain has been less disturbed and the organic content is much higher, giving rise to soils classed with the Valentine series.

Below the sand sheet lies the Arikaree formation of Tertiary age. It is exposed extensively in the extreme northwestern corner of the county. It is sedimentary from material washed down and deposited over a large part of the High Plains from the more elevated regions to the west and consists of a light-gray, soft sandstone, loosely cemented with lime. It is usually fine textured and weathers into a group of soils having brown to dark-brown surface soils underlain by light-gray to ash-colored, highly calcareous subsoils. Such soils have been classed in Antelope County with the Holt series.

Over considerable areas in the northwestern part of the county the sand sheet was separated from the Arikaree formation by a thin deposit of coarse sand and gravel. This deposit has been extensively exposed upon the sharper divides and steeper slopes. Its geological relationship is not clearly understood. It is thought to represent

coarse Rocky Mountain débris carried down by streams and deposited during late Tertiary times. The material is heterogeneous and contains waterworn fragments of a great many of the igneous and sedimentary rocks of the Rocky Mountains. Soil derived from this material has been classed as the Holt gravelly sandy loam.

The alluvial soils of Antelope County occupy the terraces or benches and the flood plains or first bottoms along streams. The benches lie well above overflow, while parts of the flood plains are subject to inundation during periods of high water.

The benches or second bottoms consist of assorted material washed down from the upland and deposited at former flood stages of the streams. They include low terraces and high terraces. The high terraces represent the oldest alluvial deposits in the county. They are of fine texture, having been derived from loessial material. The soils of the high terraces have been classed with the Waukesha series. The low terraces vary widely in soil characteristics, depending upon the character of the sediments carried by the streams at the time of their deposition. Sandy materials have given rise to soils classed with the O'Neill, Plainfield, and Sioux series, while fine-textured silty deposits have produced the Waukesha soils.

The first bottoms or flood plains are of recent origin and are subject to frequent overflow. In many places they are still in the process of formation. As with the soils of the terraces, the character of the flood-plain deposits depends largely upon the formations from which the streams derive their sediment. The upland creeks in the southeastern part of the county, passing through areas of loess soils, carry and deposit only fine-textured silty materials. The streams that are intrenched in the sand sheet underlying the loess plain carry coarser material. The merging of streams transporting deposits of such varying textures results in deposits ranging from silt loams to sands. The finer textured bottom-land deposits are classed with the Wabash and Lamoure series, and the coarser deposits are included with the Cass and Sarpy series and Riverwash.

The numerous poorly drained depressions scattered throughout the terraces and uplands have especially favored the growth and decay of vegetation and are unusually rich in organic matter. Those areas having a heavy almost impervious clay subsoil are included with the Scott series, and those underlain by loose sandy subsoils are mapped with the Gannett series.

The several series identified in the county are described as follows:

The Marshall series includes types with dark grayish brown surface soils underlain by a yellowish-brown or brown, fine-textured subsoil. The Marshall soils differ from those of the Knox series chiefly in the larger quantity of organic matter in the surface soil and upper subsoil. The series is derived from loess. The topography is rolling to gently undulating, with some small flat areas. Drainage is usually good, and in places is excessive. Four types, the Marshall loamy sand, fine sandy loam, very fine sandy loam, and silt loam are mapped in Antelope County.

The soils of the Knox series are brown to grayish brown underlain by a yellow to grayish-yellow subsoil. The loess from which they are derived has undergone less change since deposition than where soils of the Marshall series have been formed. The most important

change from the original loess is the slightly darker color of the surface soil due to oxidation and the accumulation of some organic matter. The topography ranges from sharply rolling to hilly, and drainage is usually excessive. The Knox soils contain more lime than the Marshall. The Knox silt loam is mapped in this survey.

The surface soils of the Holt series are very dark grayish brown to almost black, and are loose and finely granular. The color of the underlying horizon fades gradually downward into brown and the texture becomes somewhat heavier, but no clay pan is developed. Below depths of 24 to 30 inches the lower subsoil consists of yellowish-gray to almost white material. The carbonates have been largely removed from the surface soil and upper subsoil, but the lower subsoil is highly calcareous. These soils are derived from sandstones and shales weathered in place under semiarid prairie conditions. The Holt series is represented here by the gravelly sandy loam, sandy loam, fine sandy loam with a hilly phase, and silt loam.

The types of the Valentine series have brown to dark-brown surface soils. The subsoil differs little from the surface soil, except that it is slightly lighter in color, owing to a lower content of organic matter. Both soil and subsoil have a loose, rather incoherent structure. In Antelope County the Valentine soils are produced by the partial weathering of the sand sheet underlying the plains loess or the same material reworked by the wind. The topography ranges from nearly level to gently undulating or rolling, and the drainage is thorough. The Valentine sand, loamy sand, and fine sandy loam are mapped in this county,

The surface soils of the Gannett series are dark gray to black and contain much organic matter, which in a few places is almost abundant enough to produce a muck. The subsoil is a light-brown to grayish-white sandy loam or sand of loose, incoherent structure. The series is developed in pockets or swales throughout the more sandy parts of the county. It represents wind-blown materials mixed with fine wash from the higher lands and modified by the accumulation of organic matter. Drainage is poor, and the lower parts of the depressions remain in a marshy condition the greater part of each year. The series is represented in Antelope County by the Gannett loamy sand.

The surface soil of the Scott series is brown to black and the subsoil is a drab to grayish, heavy, plastic clay. The Scott soils consist of water-laid materials eroded from the higher lying surrounding types and deposited by surface waters in temporary lakes or ponds. They occupy local, undrained, sinklike depressions. The Scott silt loam is mapped in this county.

The Waukesha series includes types having dark-brown to black surface soils underlain by a yellowish-brown to brown subsoil. They are derived from water-assorted glacial and loessial materials and occupy terrace or bench positions along the larger streams. They have a flat to very gently undulating topography and good drainage. The soils differ from those of the Marshall series chiefly in position and mode of formation and in having a slightly more compact subsoil. The Waukesha fine sandy loam, very fine sandy loam, and silt loam are recognized in this survey.

The O'Neill series consists of brown to dark-brown surface soils underlain by a gray to light grayish brown, loose, sandy subsoil. The soils are the result of water deposition and occupy terraces along the major streams. The topography is flat to gently undulating and drainage is good. The types differ from those of the Waukesha series in the more sandy and less coherent nature of the subsoil and in the lower content of organic matter of the surface soils. In Antelope County the series is represented by the O'Neill loamy fine sand and fine sandy loam.

The soils of the Plainfield series vary from light brown or light grayish brown to brown and the subsoils are light brown or yellowish brown. The subsoils are lighter in texture than the soils and the lower subsoils often consist of loose porous gravel. Neither soils nor subsoils are highly calcareous. This series is found on terraces usually in glaciated regions. These soils are invariably droughty and have a low agricultural value.

The surface soils of the Sioux series are dark brown to almost black, underlain by a light-brown to yellowish-brown or gray, loose, incoherent subsoil. The types differ from those of the O'Neill series chiefly in the calcareous nature of the subsoil. The topography is flat to very gently undulating, usually with a slight slope down the valley and toward the stream axis, and drainage is good. The soils occupy terraces and are not subject to overflow. The Sioux loamy sand and fine sandy loam are mapped in this county.

The surface soils of the Wabash series are black and have a high content of organic matter. The subsoil is dark gray to drab. The material is of alluvial origin, having been washed from the loessial and associated uplands and deposited within the flood plains of the streams. The topography is flat. The drainage is variable, but in most places it is adequate for crop production. The Wabash very fine sandy loam and silt loam are mapped in Antelope County.

The Lamoure soils are very similar to those of the Wabash series in topographic position, mode of formation, derivation, and structure. They differ, however, in being less perfectly drained and in having a highly calcareous and usually lighter colored subsoil. The series is represented in the county by two types, the Lamoure very fine sandy loam and silt loam.

The types of the Cass series are dark brown to black in the surface soil and have a brownish-gray to light-gray sandy subsoil. They occupy flood-plain positions along the larger streams and are subject to overflow. They differ from those of the Wabash series in the more sandy and less coherent nature of the subsoil. Three types, the Cass loamy fine sand, fine sandy loam, and very fine sandy loam are mapped in Antelope County.

The soils of the Sarpy series differ from the Cass soils in the light-brown to grayish-brown color of the surface layer. The subsoil is loose, rather incoherent, and distinctly lighter in texture than the surface material. The types occupy low positions and are in general rather poorly drained. The topography is flat, except where modified by old cut-offs, stream channels, and slight elevations. The series is represented in this survey by the Sarpy sand.

The distribution of the soil types mapped in the county is shown on the accompanying soil map. The table following shows the actual and relative extent of each type:

*Areas of different soils.*

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent. |
|---|---|---|---|---|---|
| Valentine sand | 126,144 | 22.8 | Wabash silt loam | 3,968 | 0.7 |
| Valentine loamy sand | 99,776 | 18.0 | Sarpy sand | 3,968 | .7 |
| Marshall silt loam | 92,608 | 16.7 | Waukesha fine sandy loam | 3,712 | .7 |
| Marshall fine sandy loam | 47,808 | 8.7 | Sioux loamy sand | 3,584 | .6 |
| Dunesand | 22,784 | 4.1 | Cass loamy fine sand | 3,520 | .6 |
| Marshall loamy sand | 22,400 | 4.1 | O'Neill fine sandy loam | 3,072 | .6 |
| Marshall very fine sandy loam | 17,408 | 3.2 | Lamoure silt loam | 2,368 | .4 |
| Holt fine sandy loam | 10,560 | 2.6 | Holt silt loam | 2,368 | .4 |
| Hilly phase | 4,096 | | Knox silt loam | 2,048 | .4 |
| Holt gravelly sandy loam | 12,608 | 2.3 | Wabash very fine sandy loam | 1,536 | .3 |
| Valentine fine sandy loam | 11,520 | 2.1 | Lamoure very fine sandy loam | 1,088 | .2 |
| Holt sandy loam | 10,304 | 1.9 | Sioux fine sandy loam | 960 | .2 |
| Waukesha silt loam | 7,808 | 1.4 | Plainfield sand | 896 | .2 |
| Cass fine sandy loam | 7,232 | 1.3 | Riverwash | 768 | .1 |
| Waukesha very fine sandy loam | 7,168 | 1.3 | Scott silt loam | 448 | .1 |
| Gannett loamy sand | 7,040 | 1.3 | | | |
| O'Neill loamy fine sand | 6,208 | 1.1 | Total | 552,960 | |
| Cass very fine sandy loam | 5,184 | .9 | | | |

MARSHALL LOAMY SAND.

The surface soil of the Marshall loamy sand is a dark-brown to dark grayish brown loamy sand 10 to 15 inches deep. It is rather loose and incoherent, and is composed largely of medium, fine, and very fine sand, with the fine sand predominating. The surface layer of 6 inches is high in organic matter, but does not contain as much of this material as the finer textured types of the Marshall series. The subsoil is a brown to light-brown very fine sandy loam to an average depth of about 20 inches, where it changes abruptly to a light-gray or almost white friable silt containing considerable fine sand. This material continues to below the 3-foot section. The humus content gradually decreases with depth, the lower subsoil being almost devoid of organic matter. As a rule, the type is not calcareous within the 3-foot section, although below an average depth of 4 feet the lime accumulation is very noticeable.

As mapped in Antelope County, the Marshall loamy sand includes a few variations of minor importance. On the more level areas, where conditions have favored the growth and decay of plant life, the surface soil is much deeper than usual; in a few places it extends to a depth of 15 or 20 inches and rests directly upon the light-gray calcareous silt of the parent formation. In the more exposed situations, where wind erosion has retarded the accumulation of organic matter, the soil is brown to light brown in color and very shallow, the underlying loess often lying within 10 inches of the surface. Locally the silty calcareous loess is encountered only in the last 3 or 4 inches of the 3-foot section.

The Marshall loamy sand occupies numerous small patches scattered over the entire upland part with the exception of the southeast one-quarter. The type is usually associated with the soils of the Valentine series. It has been derived from the underlying loess, the surface material of which has been greatly modified by the addition of wind-blown sand.

The individual areas have very little surface relief. They occupy shallow depressions, gentle slopes, and low rounded hills and ridges.

Surface drainage is poorly established, but the porous nature of the soil and subsoil insures ample internal drainage.

The type is of little agricultural importance on account of its relatively small extent, local occurrence, and tendency to drift when not protected by vegetation. About half of it is under cultivation. The rest is used for pasture and hay land. The native vegetation consists of a good growth of sand grass, stipa, grama grass, and bluestem.

Of the cultivated crops, corn and alfalfa are the most important. Some small grain, chiefly rye, is grown, but the danger of soil blowing prevents the necessary cultivation of shallow-rooted crops. Most of the type is devoted to the grazing of beef cattle. A few hogs are raised on nearly every farm.

The type is naturally retentive of moisture and produces good yields, considering the sandy nature of the soil. During normal years the yields are somewhat lower than on the heavier textured types. In seasons of low rainfall, however, crop yields often surpass those of the Marshall silt loam and very fine sandy loam, owing to the greater water-retaining power of this type. The average yield of corn is about 25 bushels per acre. Alfalfa yields 2 to 2½ tons per acre from three cuttings.

The soil of the Marshall loamy sand is easy to handle and can be cultivated under almost any moisture conditions without injury. In preparing the soil for small grain the land is plowed only every second or third year. During the intervening years the land is double-disked before drilling in the grain. Alfalfa is sown broadcast on well-prepared stubble ground. Barnyard manure is applied when available.

Land of this type is usually sold in connection with other types. It is probably worth $75 to $95 an acre at present (1921).

Since the soil of this type blows badly when the native sod is broken, great care should be taken to protect it at all times. Large quantities of barnyard manure would prove very beneficial. It is advisable not to disturb the soil until ready to plant the grain, as it should not be left unprotected longer than is absolutely necessary. Alfalfa has proved very effective in preventing soil drifting.

### MARSHALL FINE SANDY LOAM.

The surface soil of the Marshall fine sandy loam is a dark-brown to dark grayish brown fine sandy loam 8 to 12 inches deep. It is loose and friable in structure, contains a high percentage of very fine sand and silt, and much organic matter. The upper subsoil is a brown to light-brown fine sandy loam, which gives way abruptly at an average depth of 20 inches to the light-gray calcareous silt of the underlying loess formation. Small lime concretions occur scatteringly in the lower part of the 3-foot section and are numerous in the substratum. The surface soil and upper subsoil are not highly calcareous.

The depth and color of the surface soil varies considerably with its topographic position. On the more level areas, where conditions have favored undisturbed weathering and the accumulation of organic matter the surface soil is almost black in color and in places 10 to 14 inches deep. On the more exposed situations and in the rougher areas, where stream and wind erosion have retarded weathering, the soil is locally very shallow. In a few places the sandy material has been

entirely removed, exposing the light-colored silty subsoil. Where such areas were of sufficient size to warrant mapping they were included with the Knox silt loam.

The Marshall fine sandy loam is rather extensive in Antelope County. It occupies many irregular-shaped bodies scattered throughout the upland. Some of the most typical developments occur as narrow broken strips around areas of the Marshall silt loam and very fine sandy loam. Numerous bodies are inclosed within areas of the Valentine soils. The type is in reality weathered loessial material, the surface soil of which has been greatly modified by wind-blown sands.

The topography varies from almost flat to moderately rolling, the greater part of the type having a gently undulating surface. The strips bordering the Marshall silt loam and very fine sandy loam type occupy long gradual slopes. The more isolated bodies lying within areas of Valentine soils occupy either shallow depressions or low rounded hills and ridges.

Drainage is good but generally not excessive. Surface drainage is not well established everywhere, but the surface moisture is readily absorbed by the porous soil and subsoil.

The Marshall fine sandy loam is important in the agriculture of the county. It is naturally strong and fertile, retentive of moisture, and can be cultivated under a wide range of moisture conditions without serious injury. About three-fourths of it is under cultivation and the rest is used for pasture and hay land. In the more sandy sections of the county this type is used largely for crop production, and the surrounding Valentine soils are used for grazing. The native vegetation consists of a luxurious growth of all grasses common to the region, chief among which are sand grass, grama grass, stipa, and bluestem.

Corn, oats, alfalfa, and rye are the most important cultivated crops. About 75 per cent of the cultivated land is used for corn production. Cattle raising is practiced extensively. Most of the animals are grass fed for the fall markets, although a few farmers practice winter feeding. Hogs are raised on nearly every farm. The average yield of corn is about 35 bushels per acre, oats 25 bushels, and alfalfa 2½ to 3 tons from 3 cuttings. Rye yields from 18 to 20 bushels per acre.

The Marshall fine sandy loam is easily handled and can be cultivated with less power and lighter machinery than the heavier soils of the county. Corn is usually listed in, as the soil sometimes blows when an even surface is exposed to the wind. Small grain is planted with a press drill on well-prepared corn or stubble ground. Alfalfa is usually sown broadcast on a plowed, disked, and harrowed seed bed. Some barnyard manure is used.

Land of the Marshall fine sandy loam sells for $95 to $125 an acre, depending largely on improvements and location.

### MARSHALL VERY FINE SANDY LOAM.

The surface soil of the Marshall very fine sandy loam is a dark-brown to very dark grayish brown very fine sandy loam to an average depth of 10 inches. It is loose and friable, contains considerable fine and medium sand, and in places approaches a loam in texture. The dark surface soil generally grades into the subsoil through an intermediate layer from 2 to 4 inches thick, in which the color becomes

lighter. Below this the subsoil is a brown friable very fine sandy loam to silt loam, changing at about 18 inches into a light yellowish brown or almost gray, friable, fine-grained silt. Below 30 inches a highly calcareous yellowish-gray silty clay is encountered, which continues to great depths. Lime concretions from one-eighth to one-fourth inch in diameter occur scatteringly in the lower part of the soil section and become numerous below the 3-foot depth. In a few places reddish-brown iron stains are encountered below 30 inches. The material of the lower subsoil and substratum has a columnar structure.

The color and depth of the surface soil differs considerably with its topographic position. On the more level areas and gradual slopes, where conditions have favored the accumulation of organic matter, the soil is very dark brown to almost black, and may be 18 to 20 inches deep. In such places the lower part of the surface soil is a silt loam in texture, but the immediate surface is representative of the rest of the type. In the more rolling areas where erosion is active the surface soil is shallow and in a few places has been entirely removed, exposing the light-colored highly calcareous subsoil material. Where these exposures were of sufficient size to warrant mapping they were included with the Knox silt loam. Narrow strips of colluvial material along the intermittent streams were included with this type.

The Marshall very fine sandy loam is of relatively small extent in Antelope County. It occurs in irregular broken strips around the areas of Marshall silt loam and as isolated bodies scattered throughout the upland of the county. The largest areas are in the vicinity of Elgin and south of Clearwater Creek. The type has been developed on the loessial deposit which once covered the greater part of the region. It was originally Marshall silt loam, the surface material of which has been so modified by the wind-blown sand from the Valentine types that it has assumed the texture of a very fine sandy loam.

The topography ranges from gently undulating to sharply rolling. The general surface lies somewhat below that of the Marshall silt loam. It is usually characterized by broad U-shaped valleys, gradual slopes, and moderately wide, well-rounded divides. Along the northern boundary, in the extreme northwestern corner of the county, there is a small body of Marshall very fine sandy loam which is almost flat. The most rolling relief is on the south side of Clearwater Creek. Here the valleys are rather narrow, the slopes comparatively steep, and the divides sharp. Drainage on this type is everywhere good, and in the more steeply rolling areas it is excessive in places, causing erosion to become a serious factor.

This type is an important agricultural soil in Antelope County. It is naturally strong and fertile, compares very favorably with the Marshall silt loam in crop production, and can be tilled under a somewhat wider range of moisture conditions. About 90 per cent of it is under cultivation, and the remainder, including the more strongly rolling land, is used for pasture and hay. Corn, oats, alfalfa, rye, and winter wheat are the most important crops, ranking in acreage in the order named. A few farmers feed cattle during the winter, although this is not practiced so extensively as on the Marshall silt loam. Hogs are raised for market on every farm. Most of the livestock is

of good breeding, and there are a few purebred herds of cattle and hogs. Shorthorn and Hereford are the principal breeds of cattle. The hogs are mostly of Duroc-Jersey and Hampshire breeding.

The average yield of corn is about 35 bushels, oats 30 bushels, alfalfa 3 to 3½ tons, rye 25 bushels, and winter wheat 18 bushels per acre. Wild hay yields one-half to three-fourths ton per acre. The native grasses on this type will support 50 to 60 head of cattle on each quarter section during the summer grazing season. The corn, oats, and alfalfa are usually fed to livestock on the farms where produced or are sold to local feeders. Rye and wheat are the leading cash crops, and the grain is usually hauled to the elevators direct from the threshing machines.

The selling price of the Marshall very fine sandy loam ranges from $100 to $175 an acre, depending largely upon its topography, improvements, and distance from markets.

The Marshall very fine sandy loam is tilled in much the same manner as the Marshall silt loam. It is slightly easier to handle, however, and can be cultivated with less power and lighter machinery.

The methods suggested for maintaining and increasing the productiveness and preventing erosion of the Marshall silt loam will apply admirably to this type.

### MARSHALL SILT LOAM.

The surface soil of the Marshall silt loam is a dark grayish brown to almost black, moderately heavy silt loam, 6 to 15 inches deep. It has a very high silt content and a relatively small proportion of particles coarser than very fine sand. The soil is rich in organic matter, has a very smooth and velvety feel, and breaks down readily into a fine powder. The upper subsoil usually consists of a layer of 6 to 8 inches of lighter brown, slightly more compact silt loam. Below about 20 inches the material changes rather abruptly to a light yellowish brown, heavy silt loam. This usually continues throughout the 3-foot section without change, although locally it becomes heavier with depth, and at about 30 inches consists of a compact, light yellowish brown silty clay, faintly mottled with gray. Below 36 inches or more the substratum commonly grades into a yellowish to brownish friable silt loam, containing light-gray mottlings, reddish stains, and scattering concretions of lime. This condition becomes more pronounced with depth, as is shown in deep road cuts. The structure of the soil and upper subsoil is granular, while that of the lower subsoil and substratum is columnar. The subsoil is highly calcareous, the lime existing both in the powdered form and in numerous small concretions.

The type contains a few variations, largely in the depth and color of the surface soil. On the smoother, almost flat divides and on the more gradual slopes to streams, where conditions have favored extensive weathering and the accumulation of organic matter, the soil is black in color and may be 18 to 20 inches deep. On the sharper divides, steep slopes, and shoulders of hills, where erosion has been severe, the soil is very shallow. In these positions numerous patches are almost or entirely devoid of their original surface soil, and the yellowish-brown subsoil with its limy concretions is exposed. These spots are noticeably heavier in texture, and where they are large

enough to warrant mapping they are included with the Knox silt loam. Around the margins of the type near areas of the Marshall fine and very fine sandy loams and areas of the Valentine soils, erosion and wind action have caused a rather intricate mixing of the silt and sand particles, giving rise to areas of a loamy texture, but owing to their small extent it is not possible to show them separately on the map. Along intermittent streams, narrow strips of colluvial and alluvial materials are included with this type.

The Marshall silt loam is one of the most extensive and important soils in the county. It occupies about one-sixth of the total area. The type occurs on remnants of the original loess plain which once covered the entire region. The part lying within this county has been cut through by the valley of the Elkhorn River. On the south side of the stream the type has an irregular northern boundary. It extends beyond the southern and eastern county lines into Boone and Madison Counties, where it occupies extensive areas. On the north side of the valley the type extends in a northwesterly direction as a narrow triangular strip bordering the lower lying alluvial lands. It is about 3 miles wide near the eastern county line, but gradually becomes narrower to the northwest and gives way to more sandy soils in the central part of the county.

The topography ranges from almost flat to sharply rolling, the greater part being gently rolling. The more nearly level areas are near Elgin and upon the tops of the broader divides between Cedar, St. Clair, Ives, and Giles Creeks. In the localities the drainage channels have not become well established and are broad shallow draws with gently sloping sides. The greatest relief is in Cedar Township within the Cedar Creek drainage area. The topography here is characterized by steep and, in places, almost precipitous slopes separated by narrow crestlike divides. The rest of the type has a gently rolling to rolling topography and is marked by broad U-shaped valleys separated by moderately wide well-rounded divides.

All of the Marshall silt loam is well drained, with the exception of a few isolated sinks or depressions in the more nearly level areas. These depressions seldom exceed 20 acres in size. In the strongly rolling sections drainage is excessive and erosion has become a serious factor. Here the acreage of Knox silt loam is steadily increasing as a result of the removal of the surface soil of the Marshall silt loam.

The type was originally covered with a thick growth of prairie grasses, with marginal strips of forest along the flood plains of the larger streams. The native grasses consist mainly of big and little bluestem, grama grass, and buffalo grass. The timber was composed of a fairly dense growth of elm, ash, and cottonwood. During recent years most of the prairie sod has been broken for crop production, and much of the timber used for firewood and post material. At present about 90 per cent of the type is under cultivation, and the remainder, including the rougher areas, is used for pasture and hay land.

By far the greater part of the improved land is in corn, and the rest is largely devoted to oats, alfalfa, rye, and winter wheat, ranking in acreage in the order named. Small patches of millet, spring wheat, and barley are grown for feed on many farms. The type is

recognized as one of the best upland corn soils of the Mississippi Basin.

Cattle raising is not practiced extensively, although the fattening of livestock is becoming a highly specialized industry. All the native cattle, except a few kept to supply the home needs for dairy products, are fattened for market, and in addition many feeders are shipped in from Omaha to be fattened. The native cattle on this type are chiefly grade Herefords and Shorthorns. Hogs are raised on every farm, and on a few farms the herds are large, The principal breeds are Poland-China and Duroc-Jersey. All livestock intended for market is fattened on corn and alfalfa and shipped to Omaha.

The yield of corn varies widely from year to year, depending upon the rainfall. Good yields are obtained in normal years, and in dry years the yields are probably higher than the average for eastern Nebraska, because of the high water-retaining power of the soil. The average yield is about 35 bushels per acre, although 60 to 65 bushels are common under good management. Oats are grown for feed on nearly every farm and yield from 30 to 40 bushels per acre. Alfalfa yields 3½ to 4 tons per acre from three cuttings. In exceptionally long seasons a fourth cutting may be obtained. Alfalfa is very beneficial to the land, especially in the rougher areas, as it adds both humus and nitrogen to the soil and prevents destructive erosion. The average yield of rye is about 25 bushels per acre. Rye is planted more extensively than winter wheat on account of its higher yield. Wheat yields from 15 to 20 bushels, with an average of about 18 bushels per acre. The acreage of wheat was increased during the last few years in response to pressing demand and high prices.

Crop rotation is not systematically practiced on the Marshall silt loam, though a few farmers use a rotation consisting of corn one or two years, followed by oats or wheat one year and alfalfa six or seven years. Many farmers grow the same grain crop for several years in succession. Improved modern machinery is used. On the steeper slopes the operation of heavy implements is rather difficult and cumbersome. Four horses are used in performing most of the farm work. On the more level lying areas tractors are sometimes used for plowing, but the uneven topography over the greater part of the type prevents their extensive use.

Most of the corn is planted in check rows, although on much of the type the corn is listed in. Wheat is usually sown in the fall and is generally drilled in on plowed and double-disked corn or stubble ground. The land for oats is prepared the same as for wheat, but the seed is sown in the spring. Alfalfa is sown broadcast on well-prepared stubble ground. Manure is applied when available. It is usually placed on the more eroded areas where the surface soil is rather shallow.

Land of the Marshall silt loam sells for $100 to $175 an acre, depending upon topography, improvements, and location with respect to markets.

This type is naturally fertile, and every possible means should be used to maintain its present producing capacity. In the absence of an adequate supply of manure the productiveness of the type can not be long maintained unless a leguminous crop such as alfalfa or clover is grown at least once in every four years. Where livestock is not

kept in considerable numbers, clover may be plowed under as green manure in the year following the season of seeding. It is good practice to plow the entire crop under where the soil is very deficient in nitrogen. The yield of winter wheat is materially increased by early plowing. The superiority of thorough seed-bed preparation for corn over the method of listing the crop is understood by most farmers.

The control of erosion is important in the more steeply rolling areas. With the gradual depletion of organic matter and the continued washing away of the surface soil, the land is left in a much less productive condition and also becomes gullied and uncultivable. The tendency to wash may be retarded by deep cultivation to facilitate the absorption of water and by having the rows, especially of listed corn, follow contour lines. Alfalfa is also very valuable in checking erosion.

### KNOX SILT LOAM.

The surface soil of the Knox silt loam is a light-brown or yellowish-brown mellow silt loam, 4 to 7 inches deep, which is largely composed of silt and has a very smooth floury feel. It is almost devoid of organic matter, as the color indicates. The subsoil is a grayish-yellow to very light grayish brown friable silt, which has a pronounced open and columnar structure and continues to great depths. It contains white mottlings and reddish-yellow iron stains below 30 inches. Both soil and subsoil are highly calcareous, and lime concretions are common on the surface and throughout the soil section.

The soil differs considerably from the Knox silt loam found along the eastern boundary of Nebraska and in western Iowa. There the soil occurs in forested areas and owes its color and other properties to the influence of a forest vegetation. The surface soil has a richer brown color, and the entire 3-foot section is more thoroughly leached as a rule than in this area. In places effervescence with acid will barely take place above 3 feet, while here the carbonates extend almost to the surface. In this county the Knox silt loam has not been developed under a tree growth but occurs where erosion has exposed the light-colored, partly weathered loess.

The Marshall silt loam and Knox silt loam differ in that the former has a darker color, due to a higher content of organic matter. The Knox silt loam in Antelope County is really an eroded phase of the Marshall silt loam, from which the original dark-colored surface soil has been removed. The two types are similar in texture and color of subsoil. The process of formation is directly opposite in the Marshall and Knox soils. The Marshall soil contains an accumulation of decomposed organic matter resulting from the growth and decay of plant life, while the Knox soil is produced by removal of the dark-colored surface material.

As mapped in the county, the Knox silt loam includes a few minor variations. In local areas, where erosion has been less severe, the surface layer of 2 to 6 inches is a brown to grayish-brown silt loam underlain by 2 to 4 inches of a lighter brown silt loam, which passes into the calcareous subsoil. These areas represent a transition stage between true Marshall and Knox soils, and if they were large enough to warrant separate mapping they would be classed as a dark-colored phase of the Knox silt loam. In places where erosion has been

especially severe, the white calcareous subsoil is exposed. Some of these exposures are heavy in texture, consisting of silty clay loam to silty clay.

The Knox silt loam occupies small, usually circular areas scattered throughout the areas of Marshall silt loam in the southeastern part of the county. The bodies vary in size from a few acres to about one-fourth square mile, but most of them do not exceed 60 acres. The type occupies the sharp crests of ridges, hilltops, and steep slopes, where the surface soil of the Marshall type has been largely or entirely removed by erosion. In many places the gradation between the Marshall and Knox soils is almost imperceptible, and in many places arbitrary lines were drawn to separate the two. In general the Knox silt loam was held to those bodies having a light-colored surface soil. Drainage is excessive over all the type.

Owing to its small extent, unfavorable topography, low content of organic matter, and tendency to erode, the type is of little agricultural importance. It is productive when well managed, and about 80 per cent of it is under cultivation. The same crops are raised as on the Marshall silt loam, the yields being slightly lower. The type is handled in the same manner as the Marshall silt loam, except that greater care is usually taken to prevent erosion and most of the manure produced on the farm is applied to this soil. The supply of manure is seldom sufficient for best results.

The Knox silt loam is usually held in conjunction with the Marshall silt loam, and slightly reduces the value of farms containing it.

This type can be protected from washing to a greater extent than at present by plowing along contour lines and to a greater depth. The growing of a much larger acreage of leguminous crops, to which the soil is so well adapted, would be beneficial. The type is recognized as especially adapted to small fruit. The climate in Antelope County apparently limits the production of certain kinds of fruit, but the fruit-growing industry could undoubtedly be profitably practiced. Good yields of potatoes are produced on this type in other counties.

### HOLT GRAVELLY SANDY LOAM.

The Holt gravelly sandy loam is a brown loose sandy loam, generally containing an abundance of coarse sand and gravel, consisting of waterworn fragments of a great variety of crystalline rocks. Locally the surface layer of 6 inches is slightly darker in color, owing to an accumulation of organic matter. The brownish color extends to a depth of 15 to 20 inches, where the material becomes grayish or light-brownish in color. In many of the rougher areas the type shows little change in either color or texture within the 3-foot section. In the more nearly level areas, however, there is a relatively large proportion of finer materials in the surface 8 inches, consisting chiefly of the finer grades of sand, with some silt and clay.

The Holt gravelly sandy loam is not extensive in Antelope County. It occurs chiefly in the northwestern part, where it occupies high sharp divides and steep slopes within the Verdigris Creek drainage basin. The material is thought to be Rocky Mountain débris carried down by streams and deposited during the late Tertiary times. It has in reality less of the characteristics of a soil type than of a geolog-

ical formation, the surface of which has been slightly modified by the addition of organic matter.

The topography is sharply rolling to hilly. Stream erosion has produced deep, steep-sided valleys separated by narrow, crestlike divides. Drainage over most of the type is excessive, and erosion is removing the finer materials as fast as they accumulate.

None of the type is under cultivation. It supports a fair growth of grama, buffalo, and bunch grasses, which afford good pasturage. Stock raising is the principal industry. The native grasses will support 100 to 150 head of cattle per square mile during the summer grazing season. The rough topography affords protection for livestock during severe weather. The land is valued at $10 to $20 an acre, depending upon improvements.

### HOLT SANDY LOAM.

The surface soil of the Holt sandy loam is a dark-brown to almost black, loose sandy loam, 8 to 12 inches deep. It is rich in organic matter, contains considerable fine gravel, and is relatively low in content of silt and clay. The upper subsoil is brown to light-brown, loose sandy loam to an average depth of 24 inches. The lower subsoil is a loose, incoherent mass of coarse sand and fine gravel which extends below the 3-foot section. It is noncalcareous and varies in color from very light brown to almost gray. In places the upper subsoil between the average depths of 10 and 20 inches contains a large proportion of clay and in a few places is a brown to light-brown sticky sandy clay, underlain by loose coarse sand and fine gravel.

The type is relatively inextensive in Antelope County. It occupies a considerable part of Verdigris and Eden Townships, in the extreme northern part, and a few small scattered areas in Royal, Bazile, and Crawford Townships. The larger bodies are not uniform throughout but include patches of other types. The type has been derived from the same general formation that has given rise to the other Holt soils. Its coarser nature may be due to a variation in the parent rock or to reworking and shifting of the materials.

The topography is almost flat to very gently undulating, modified by shallow U-shaped valleys where crossed by drainage ways. The greater part occupies relatively flat tables around the heads of tributaries leading into Verdigris Creek. Surface drainage is good, as there is usually sufficient slope to carry off the surplus moisture. The underdrainage as a rule is excessive owing to the porous nature of the soil and subsoil. Crops sometimes suffer from lack of moisture.

The Holt sandy loam is of little agricultural importance on account of its small extent and droughty nature. Its even topography, however, favors cultivation, and about 90 per cent of it is used for crop production. The remainder is pasture and hay land. The type supports a luxuriant growth of all grasses common to the region, including grama grass, buffalo grass, western wheat grass, stipa, and bluestem. Of the cultivated crops, corn, oats, wheat, and rye are the most important. Beef cattle are raised extensively and there are a few hogs on nearly every farm.

Crop yields are somewhat lower than those obtained on the heavier Holt soils, and during dry years suffer considerably from lack of

moisture. The average yield of corn is about 25 bushels per acre, oats 25 to 30 bushels, and rye 15 to 18 bushels. Alfalfa is seldom grown on account of the low lime content in both soil and subsoil.

The soil of the Holt sandy loam is easily handled and can be cultivated under any moisture conditions without serious injury. The surface material is quite stable, considering its incoherent structure, and seldom blows badly except during exceptionally dry years.

Land of the Holt sandy loam sells for $60 to $100 an acre, depending largely upon improvements.

The table below gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Holt sandy loam:

*Mechanical analyses of Holt sandy loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 374332 | Soil, 0 to 10 inches | 3.6 | 19.1 | 15.1 | 37.0 | 10.6 | 9.4 | 5.2 |
| 374333 | Subsurface, 10 to 24 inches. | 1.0 | 9.4 | 13.1 | 39.3 | 18.4 | 10.5 | 8.3 |
| 374334 | Subsoil, 24 to 36 inches..... | 10.8 | 24.8 | 14.0 | 36.7 | 6.3 | 1.0 | 6.4 |

HOLT FINE SANDY LOAM.

The surface soil of the Holt fine sandy loam is a dark-brown to very dark grayish brown, loose, fine sandy loam, containing a relatively high percentage of fine and very fine sand, a little gravel, and considerable organic matter. It has an average depth of about 8 inches. The upper subsoil is a brown to grayish-brown, fine to very fine sandy loam, generally loose and friable, but in places slightly more compact than the surface soil. At a depth of 24 to 30 inches the subsoil usually becomes a light-gray, highly calcareous silt loam to very fine sandy loam. Fragments of the Arikaree bedrock are occasionally encountered in the lower part of the 3-foot section. In many places on the slopes the surface soil has been washed or blown away and the whitish calcareous material exposed.

In a few places gravel is thickly scattered over the surface of the type. Where these gravelly areas were of sufficient size to warrant mapping they were included with the Holt gravelly sandy loam.

The Holt fine sandy loam occurs chiefly in the extreme northern part of the county in close association with the silt loam, sandy loam, and gravelly sandy loam of the Holt series. It occupies numerous small bodies within the Verdigris Creek drainage area. The type has been formed by the weathering in place of the underlying Arikaree formation. The large sand content has probably resulted either from the addition of wind-blown material from areas of more sandy types or from a gradual removal of the finer particles through leaching or wind action.

The type occupies broad well-rounded divides and gentle slopes. It has a nearly flat to gently rolling surface, the more rolling land being in the immediate vicinity of stream channels. Drainage is everywhere good though seldom excessive. Over much of the type it is difficult to trace drainage channels, as the surplus water quickly sinks into the loose, porous soil and subsoil.

Owing to its moderate extent the type is of little agricultural importance in Antelope County. Most of the type is used for pasture and hay land, and a relatively small acreage is under cultivation. The native vegetation consists of a great variety of pasture and hay grasses, chief among which are grama grass, buffalo grass, needle grass, sand grass, and bluestem. Corn, oats, and alfalfa are the most important cultivated crops. Some rye is grown. Wheat is not extensively grown because it is difficult to obtain a firm seed bed. Most of the type is included in stock farms and ranches devoted chiefly to raising beef cattle. Nearly every farm has a small quantity of dairy products to sell. Hogs are raised in small numbers on many farms.

The type will support from 150 to 200 head of cattle per square mile during the summer grazing season. The average yield of corn is about 25 bushels per acre, oats 25 to 30 bushels, rye 20 bushels, and alfalfa 2 to 2½ tons from three cuttings. Native grasses yield one-half to three-fourths ton of hay per acre, depending upon the seasonal conditions.

The soil is easily handled and can be cultivated immediately after heavy rains without danger of clodding or baking. Its power to hold moisture is somewhat lower than that of the Holt silt loam. The same general methods of cultivation are followed as on the Holt silt loam.

Land of the Holt fine sandy loam can be bought for $40 to $60 an acre, depending largely upon improvements.

The type is naturally very productive and in average years good yields are obtained. There is some danger of soil drifting when the surface material is kept in a loose condition, and it is advisable to grow only those crops that require minimum tillage.

*Holt fine sandy loam, hilly phase.*—The hilly phase of the Holt fine sandy loam differs from the type chiefly in the rougher nature of its topography and the consequently shallower soil depth. The surface of the greater part of the phase is very rugged and not adapted to cultivation. Stream erosion has produced deep, steep-sided valleys separated by narrow crestlike divides, giving the phase a decidedly hilly relief. Erosion has also prevented weathering and the accumulation of organic matter. The resultant soil is rather shallow and light colored, consisting of a brown to light-brown fine sandy loam, 6 to 8 inches deep, underlain by a grayish-brown, fine to very fine sandy loam, which usually rests upon the parent rock within the 3-foot depth. In many places the white calcareous bedrock is exposed, giving the soil a spotted appearance.

The phase occurs only in the northwestern part of the county in close association with the other Holt soils. It has been derived from the underlying Arikaree formation under conditions unfavorable for deep soil weathering. Drainage is good throughout, and in most places is excessive, the run-off being so rapid as to cause severe erosion.

All of the phase is used for pasture land. It supports a fair growth of grama, buffalo, and needle grasses. Big and little bluestem grow to some extent on the more gradual slopes and broader divides. The native grasses will support from 100 to 125 head of cattle per section during the summer grazing season.

Land of the Holt fine sandy loam, hilly phase, sells for $10 to $25 an acre, depending upon improvements and topography.

HOLT SILT LOAM.

The surface soil of the Holt silt loam is a dark-brown to dark grayish brown silt loam, with a variable content of very fine sand, a loose and friable structure, and an average depth of 8 to 10 inches. The immediate surface layer is somewhat darker than the lower part owing to a higher content of organic matter; the darker soil is noticeable principally upon the flatter areas. The upper subsoil is a light-brown mellow silt loam passing into a gray or grayish-brown almost pure silt or silty clay. In a few places the upper subsoil is slightly heavy in place, but grinds up into the typical material. The lower subsoil below a depth of about 24 inches is a loose floury silt, very light gray to almost white in color.

The surface soil has a moderate lime content, the subsoil is calcareous throughout, and the white material in the lower part is largely composed of lime. Fragments of limestone or calcareous sandstone are present locally below 30 inches. The unweathered Arikaree formation usually lies deeper than 3 feet, though in the more rolling areas it outcrops in places, giving rise to the characteristic white spots on hillsides.

The Holt silt loam is developed in a few small areas in the extreme northern part of the county, where erosion has removed most of the sand and loess mantles, exposing the calcareous sandstone of the Arikaree formation, from which the type is derived. The largest area containing about 1½ square miles, lies along the northern county line about 2 miles east of Verdigris Creek. Most of the other areas do not exceed 320 acres in size.

The topography ranges from almost flat to gently undulating. By far the greater part of the type occupies high, broad divides or smooth, gentle slopes. It is most rolling in proximity to the eroded belts along stream channels. The drainage is good but as a rule not excessive. Even in the nearly flat situations there is sufficient slope to afford an outlet for the surface water, and the porous subsoil and substratum insure ample underdrainage.

The type is not important agriculturally because of its small extent. It is a naturally fertile soil and in counties where it occurs extensively is one of the best farming soils. About 60 per cent of it is under cultivation and the rest is used for pasture and hay land. The native vegetation consists of a luxuriant growth of grama grass, buffalo grass, western wheat grass, with some big and little bluestem.

Corn, oats, alfalfa, and rye are the most important cultivated crops. Winter wheat is grown to a small extent. The corn, oats, and alfalfa are grown to supply the local feeding demands. Wheat and rye are cash crops. Much of the type is included in stock farms and ranches on which beef cattle are raised. A quarter section will support 50 or 60 head of cattle during the summer grazing season, or when cut for hay will yield 50 to 80 tons, depending on the rainfall. The average yield of corn is about 30 bushels per acre, oats 25 to 30 bushels, rye 20 bushels, and wheat 18 bushels. Alfalfa yields 2½ to 3 tons per acre from three cuttings.

The Holt silt loam is easily kept in good tilth when properly managed. If it is plowed when wet it may form clods, but these are easily reduced. More power is generally required in tillage than on

the more sandy types. No definite crop rotation is practiced, as the soil is "new" and in no immediate danger of becoming exhausted. Small grains are usually drilled in on old stubble or corn land. Corn is usually listed. Barnyard manure is applied to the land when available.

This type is usually sold in connection with grazing land. Under present market conditions it is probably worth $50 to $60 an acre, depending upon improvements.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Holt silt loam:

*Mechanical analyses of Holt silt loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 374338 | Soil, 0 to 10 inches.. | 1.2 | 4.5 | 3.0 | 9.0 | 29.6 | 41.7 | 11.2 |
| 374339 | Subsoil, 10 to 36 inches..... | .4 | 3.2 | 6.2 | 49.2 | 19.5 | 10.1 | 11.3 |

VALENTINE SAND.

The surface soil of the Valentine sand consists of a loose incoherent grayish-brown sand 10 to 14 inches deep. The upper layer of 4 inches is usually somewhat darker than the lower part, owing to a small amount of organic matter, but this material is never sufficient to prevent the soil from drifting when the protective vegetation is removed. The subsoil is a loose incoherent sand which extends below the 3-foot depth. It is usually gray in color, although local patches have light-brown to pale reddish brown tints. Neither soil nor subsoil is highly calcareous. The soil material is largely composed of the medium, fine, and very fine grades of sand, with the medium sand predominating, and consists mainly of quartz and feldspar. In a few places small pebbles are scattered on the surface of the type.

The color and depth of the surface soil varies somewhat with its topographic position. In the shallow depressions where conditions have been most favorable for plant growth and decay the soil is somewhat darker and deeper than usual. On the crests of the low, rounded knolls and ridges the organic matter has been largely removed by the wind, leaving the soil quite shallow and prevailingly light in color. The soil differs from the Dunesand, which it closely resembles, in its smoother surface and the absence of drifting sand. The sand grains are also slightly more rounded and less angular than those of the Dunesand.

The Valentine sand is the most extensive soil type in Antelope County. It occupies the greater part of the sand plain covering the central, northeastern, and southwestern parts. It is not continuous throughout the area of its occurrence, but includes many areas of other types within its borders. The type is exceptionally well developed in Custer, Ellsworth, and Royal Townships in the central and north-central parts of the county. The Valentine sand is derived in part from the sand sheet underlying the plains loess and in part from blown sands of the surrounding types.

The type varies from almost flat to rolling, the greater part being gently rolling. The flatter areas are usually modified by scattering, low, rounded knolls and ridges. Over considerable areas the surface is choppy or hummocky. Drainage is everywhere good and in many places excessive. There is very little run-off, but the porous sands absorb and carry off the moisture as fast as it accumulates.

The Valentine sand is of little value for crop production on account of its low content of organic matter, low water-retaining capacity, and the danger of drifting when the native sod is destroyed. Probably not over 20 per cent of it is under cultivation. A few of the more favorably situated areas, especially in the lower depressions where crops can get moisture through seepage, are used in the production of corn and alfalfa. Small grain is seldom grown because of the loose nature of the sand bed. Alfalfa does fairly well under the most favorable conditions. It is extremely difficult, however, to get a stand, and the crop seldom lasts more than three or four years on account of the low lime content in the soil. Yields of all crops are usually low except in the most favorable years.

Most of the land remains with its original covering of grasses and is used for cattle grazing and hay production. The native vegetation consists of sand grass, stipa, big and little bluestem, and some grama grass. These grasses will support from 200 to 300 head per square mile during the grazing season from about June 1, or when cut for hay will yield from 350 to 450 tons per section, depending upon the rainfall. Most of the cattle are raised on the ranches and shipped as feeders to Omaha when 2 or 3 years old. A few ranchers ship in cattle for summer grazing. Grade Herefords and Shorthorns are the principal types. Dairying is not practiced extensively, although every ranch is well supplied with dairy products, and many farmers sell butter and cream to the local markets.

Land of the Valentine sand sells for $50 to $75 an acre. The price depends largely upon the improvements, topography, and location of the land with respect to markets.

The type seems to withstand drought as well as the Valentine loamy sand. It is less stable, however, and blows badly when not protected by a vegetative covering. Coarse manure and straw spread over the land have proved beneficial in preventing excessive drifting. Corn is usually deeply listed. While it is possible to grow crops on this type, it would seem that the practice is detrimental to the soil, as it is very difficult to prevent drifting when the land is brought under cultivation.

### VALENTINE LOAMY SAND.

The surface soil of the Valentine loamy sand is a dark-brown to dark grayish brown loamy sand 8 to 15 inches deep. It is largely composed of fine and medium grades of sand, with sufficient organic matter to give it a loamy texture. The subsoil is a brown to yellowish-brown, loose, incoherent sand locally tinged with red. It usually contains barely enough silt and clay to make it slightly coherent when wet. Neither the soil nor subsoil is calcareous. The type differs from the Valentine sand only in the larger humus content of the surface soil and consequently darker color. In the flatter areas, where conditions have especially favored the growth and decay of plant life, the surface soil to a depth of 8 inches is a dark-brown to

almost black loamy sand. On the low ridges and knolls, however, the soil is shallow and much lighter in color. The organic content over the entire type gradually decreases with depth and the lower subsoil is almost devoid of humus. In a few places small waterworn pebbles occur thinly scattered over the surface.

The Valentine loamy sand is extensively developed in Antelope County. It occupies large irregular-shaped bodies in all parts of the county with the exception of the loess plains section in the southeast corner. Much of the type lies within areas of Valentine sand. The origin of the soil is difficult to determine. It probably has been developed upon material derived originally from the sand sheet underlying the plains loess, which has been shifted by wind and water, redeposited, and subsequently weathered.

The surface is flat to gently undulating, broken by small ridges and knolls composed of almost pure sand. The type as a whole lies somewhat below the general level of the Valentine sand and has a slightly more even topography. Surface drainage has not been established, as the rainfall readily sinks into the porous sand and there is practically no run-off.

The Valentine loamy sand is a much better agricultural type than the Valentine sand. About 60 per cent of it is under cultivation, and the remainder is used for hay and pasture land. The native vegetation consists largely of sand grass, needle grass, grama grass and bluestem. The type does not contain sufficient organic matter to prevent drifting when the native covering of grasses is removed, and for this reason is not so well adapted to crop production as some of the heavier soils. A quarter section will support 50 to 60 head of cattle during the summer grazing season, or when cut for hay will yield from 80 to 100 tons.

Of the cultivated crops, corn is the most important, followed by oats, rye, and alfalfa. The corn is listed deeply to prevent drifting and to conserve soil moisture. Small grains are drilled in on disked corn or stubble ground. The land is plowed only every two or three years. Barnyard manure is applied when available. Alfalfa is grown occasionally but the low lime content greatly shortens its life, and stands usually die down or become very thin after two or three years. However alfalfa is an excellent crop for this soil, as it prevents drifting and adds nitrogen and organic matter.

Crop yields vary greatly from year to year, depending upon the rainfall. The type is rather retentive of moisture, considering its loose sandy nature, and during exceptionally dry years the yields compare very favorably with those obtained on the heavier Marshall soils. In normal years, however, the hard-land soils give much larger returns. The average yield of corn is about 20 bushels per acre, oats 20 bushels, rye 18 bushels, and alfalfa 2 to 2½ tons from three cuttings. The yields of winter wheat are low on account of the difficulty in obtaining a firm seed bed. In favorable seasons from 12 to 15 bushels per acre are obtained.

The selling price of the Valentine loamy sand ranges from $10 to $60 an acre, depending upon location, topographic position, and improvements.

Although the soil of this type is slightly more stable than that of the Valentine sand, it drifts badly when the protective covering of grasses is removed, unless great care is taken to protect it at all

times. Large quantities of barnyard manure should prove very beneficial. It is advisable not to disturb the soil until ready to plant, as it should not be left unprotected longer than is absolutely necessary.

### VALENTINE FINE SANDY LOAM.

The surface soil of the Valentine fine sandy loam is typically a grayish-brown to dark grayish brown, loose, friable, fine sandy loam, averaging about 12 inches in depth. In many places it contains a relatively large proportion of very fine sand and silt, giving it a somewhat heavier texture. Locally it contains a little fine gravel. The upper part is considerably darker than the lower part, owing to a larger accumulation of organic matter. The subsoil differs little from the soil except that it becomes gradually lighter in color and texture with depth and at about 20 inches is a brown to grayish-brown, loamy fine sand to fine sand. In some places the subsoil has a greater though varying content of silt and clay below 24 inches, which makes it more compact and sticky. Both soil and subsoil are deficient in lime. The type differs from the Valentine loamy sand chiefly in its finer texture, larger content of organic matter, and more stable nature. It does not, however, contain enough organic matter to prevent drifting when left unprotected.

The type has a rather small total area in Antelope County. It occupies irregular-shaped bodies, usually of small extent, scattered over the sandier uplands, usually in close association with the Valentine sand and loamy sand types. One of the largest bodies lies in the northern part of Lincoln Township, in the extreme southwestern part of the county. A smaller area is in the northern part of Blaine Township. The type is also well developed north of Orchard, in Sherman Township.

The sand of which the type is so largely composed was probably derived in part from the sand sheet underlying the plains loess and in part through the accumulation of materials by wind and colluvial action. To the original materials there have been added finer particles washed from the adjacent sandier types, which make the soil more stable than the coarser Valentine soils.

The Valentine fine sandy loam lies somewhat below the general level of the sand and loamy sand types and occupies shallow depressions having a flat to very gently undulating surface. Drainage is good though not excessive. The porous soil and subsoil readily absorb the surplus moisture and carry it off through subterranean channels.

Owing to its small extent the type is not important. It is well adapted to crop production when carefully managed to prevent soil blowing. The loose porous structure permits the rainfall to enter rapidly and makes it easy to get the surface in condition to hold the absorbed water. About 70 per cent of it is under cultivation, the rest being used for pasture and hay land. The native vegetation consists of the same grasses as on the other Valentine types. Corn, oats, rye, and alfalfa are the most important cultivated crops.

Corn and oats are grown chiefly for feed on the farms and ranches. Corn gives an average yield of about 25 bushels per acre, and oats about 30 bushels. Rye yields from 16 to 18 bushels. Alfalfa is not

grown extensively on account of the difficulty experienced in obtaining a stand. The low lime content of the soil also greatly shortens the life of the plant, and stands seldom last longer than two or three years. The crop yields from 1½ to 2½ tons per acre from three cuttings. The native grasses produce one-half to three-fourths ton of hay per acre, and the type will support 250 to 300 head of cattle per square mile during the summer grazing season from June to October.

Land of the Valentine fine sandy loam can be bought for $50 to $100 an acre, depending upon improvements and location with respect to railroads and markets.

While this soil is naturally more fertile and more retentive of moisture than the more sandy members of the series, the surface soil should not be too well pulverized because of the danger of drifting.

### GANNETT LOAMY SAND.

The Gannett loamy sand to a depth of 8 to 12 inches is a dark-brown to very dark grayish brown material composed of medium, fine, and very fine sand, together with a large proportion of well-decayed organic matter. The color and structure of the soil varies with the organic content. In the more poorly drained situations, where plant growth and decay have been favored, the soil is black in color, spongy in structure, and noticeably light in weight. In a few places the content of organic matter is so high that the soil closely resembles a muck. The subsoil is a gray to light grayish brown, incoherent, fine to medium sand, relatively low in organic matter and lacking the porous compressible structure of the surface soil. It continues to great depths. In a few places where drainage is exceptionally poor a thin layer of dark-gray sandy clay is encountered below 30 inches. The color change between the soil and subsoil is very abrupt. The entire soil section is usually calcareous.

The texture of the type as found in Antelope County is not uniform throughout. In many places the surface material contains such a high percentage of fine sand and silt that it is in reality a fine sandy loam. In some places these patches are very numerous though not of sufficient size to warrant separate mapping.

The type has a rather small total area in Antelope County. It occupies scattered depressions, usually of small extent, throughout the areas of Valentine soils. The largest developments are within the Willow Creek Valley in the east-central part of the county.

The type has been developed on the same materials as the Valentine soils, but has been modified more by the growth and decay of vegetation. A shallow water table, permitting the heavy meadow grasses to make a rank growth, is very characteristic of the type. The topography is flat to very gently undulating, and drainage is usually poor. The lower situations are in many places occupied by shallow lakes or marshes.

Owing to its small extent and poor drainage the Gannett loamy sand is of little agricultural importance. All of it is used for pasture and hay. It supports a luxuriant growth of water-loving grasses and sedges, which will support a cow or horse per acre when grazed during the summer season, or when cut for hay will yield about 1 ton per acre. The hay produced on the type is somewhat coarser and sells for a lower price than that obtained from most of the upland

soils. Its greater yield, however, in a large measure offsets its lower quality. Most of the hay is fed on the farms where produced, though a small amount is baled and shipped to outside markets.

The selling price of the Gannett loamy sand ranges from $25 to $60 an acre, depending largely upon drainage and location with respect to markets.

SCOTT SILT LOAM.

The surface soil of the Scott silt loam is a very dark brown to black heavy silt loam 6 to 12 inches deep. It contains a relatively large percentage of clay and in a few of the more poorly drained areas resembles a silty clay in texture. The subsoil consists of a black heavy clay to an average depth of 18 inches, below which the material gradually becomes lighter in color and at 24 inches is a dark-gray to slate-colored, heavy, stiff, and compact clay. Rusty-brown mottlings are encountered locally below 30 inches. The change in color throughout the soil section is very gradual. The material is not usually very calcareous within the 3-foot depth, though in a few places the lower subsoil is a less compact, gray silty clay which is highly calcareous. In places a layer of ashy-gray silt from 2 to 4 inches thick is encountered between the surface silt loam and the heavy clay of the subsoil.

The type occupies small basinlike depressions, locally known as "buffalo wallows," within areas of Marshall soils. It is developed mainly in Cedar Township in the southeastern part of the county. The basins seldom contain more than 30 acres and are very scattered. The drainage is poor, and in the spring after heavy rains water stands on the surface for periods of a few days to several weeks.

The type has been formed by wash from the surrounding higher land, deposited over older material which now constitutes the subsoil. The lower subsoil, which is high in organic matter, apparently is a very old soil formed by the deposition of clay and silt in standing water.

Owing to its small extent and poor drainage the type is not used for crop production. The native vegetation consists of sedges and other water-loving plants, with prairie grasses along the borders of the areas. Most of the land is used for grazing, but some wild hay is produced.

The greatest need of this type is adequate drainage. Where the depressions are deep, however, it is doubtful whether the increased production would compensate the expense involved in draining.

WAUKESHA FINE SANDY LOAM.

The surface soil of the Waukesha fine sandy loam is a dark grayish brown, loose, friable fine sandy loam 8 to 10 inches deep. It is rich in organic matter and under natural field conditions is almost black in color. The upper subsoil is a brown sandy clay, underlain at an average depth of 16 inches by a heavy, compact sandy clay of yellowish-brown to grayish-brown color, which usually continues to below the 3-foot depth. In places the subsoil becomes less compact below 30 inches and is slightly lighter in color than typical. The soil and upper subsoil are not calcareous. The lower subsoil usually contains some calcareous material in finely powdered form; over most of the

type it is barely sufficient to react with dilute hydrochloric acid. In a few places small lime concretions are encountered below 30 inches and the lower subsoil is highly calcareous.

Around the outer margins of this type, especially where it borders areas of the Valentine and O'Neill soils, the surface soil contains a larger percentage of coarse and medium sand, and in many places is a sandy loam in texture. These areas were of such small extent that they were not separated from the main type.

The Waukesha fine sandy loam is developed chiefly on the lower terraces along the Elkhorn River, with a few bodies along the larger tributary creeks. One of the largest and most uniform areas is on the south side of the river northwest of Tilden, and another lies just north of Oakdale. Smaller bodies occur on the north side of the river in the western part of the county. The total area of the type is about 6 square miles.

The topography is flat to very gently undulating and drainage is everywhere good. Surface channels are not well established but underdrainage is well developed.

The Waukesha fine sandy loam is a very strong fertile soil and would be an important type if it were extensive. It is adapted to all crops common to the region and practically all of it is under cultivation. Corn, oats, and alfalfa are grown chiefly. Cattle feeding is practiced on a few farms and hogs are raised for the market on every farm. Most of the cattle to be fattened are shipped in from Omaha, though many feeders are bought from the surrounding farms. The majority of the cattle are grade Herefords and Shorthorns. The hogs are mostly of the Duroc-Jersey breed.

Crop yields vary greatly from year to year, depending upon the rainfall. The average yield of corn for a period of several years is about 35 bushels per acre, oats 30 bushels, and alfalfa 3 to 3½ tons per acre from three cuttings. The type is not considered so well adapted to small grain as the heavier terrace soils because the loose nature of the surface soil prevents the preparation of a compact seed bed.

The soil is handled in much the same manner as the Marshall silt loam. It can be cultivated under a wider range of moisture conditions and with lighter machinery and draft animals. Although crop rotation is not systematically practiced, the more progressive farmers are planting more alfalfa each year, raising more livestock, and applying the manure to the land in an effort to maintain the high producing power of the soil.

Land of the Waukesha fine sandy loam sells for $100 to $150 an acre, depending largely upon improvements and location. A few farms in the immediate vicinity of the towns might bring $300 an acre.

### WAUKESHA VERY FINE SANDY LOAM.

The surface soil of the Waukesha very fine sandy loam is a dark grayish brown very fine sandy loam 10 to 14 inches deep. It is loose and friable and contains a large amount of organic matter, which gives it its dark color and mellow structure. The upper subsoil consists of a layer of 6 to 12 inches of brown silty to very fine sandy loam, slightly heavier and more compact than the surface soil. At an average depth of 24 inches the subsoil changes rather abruptly to a heavy,

stiff, silty clay of light-brown to gray color. This layer is slightly compact when dry but becomes sticky and plastic when wet. It contains scattering yellowish and light-brown splotches which in a few places become so numerous as to give the material a faintly mottled appearance. Below an average depth of 32 inches the subsoil is a light-gray or light yellowish brown floury silt to silty clay. As a rule the material is not calcareous within the 3-foot section, although lime becomes abundant below the 4-foot depth, in both the powdered form and in small concretions.

As mapped in this county the type includes several variations. Over considerable areas there is no noticeable accumulation of clay in the subsoil. The surface soil in these localities consists of a dark-brown very fine sandy loam, 10 to 18 inches deep, underlain by a brown friable silt loam extending to an average depth of 30 inches, below which the subsoil is a light-gray floury silt having a high lime content.

In several places, especially where the land slopes gradually from the terraces to the edge of the uplands, large amounts of colluvial wash from the higher levels have greatly thickened the surface soil, so that it has an average depth of about 24 inches and in small patches extends to below the 3-foot section without change in color or texture. If this variation were extensively developed it would have been classed with the Judson very fine sandy loam (a colluvial soil), but owing to its irregular occurrence and small total extent it was not separated on the soil map.

The type has a rather small area in this county. It occurs chiefly on the low terraces bordering the Elkhorn River flood plain, although areas of considerable size occur in Logan and Elgin Townships along one of the larger tributaries of Cedar Creek. Elgin, Oakdale, and Neligh are situated in part on this type.

The soil has been developed on alluvial material carried down and deposited by the streams when they were flowing at a higher level than at present. Subsequent deepening of the channels has left the deposits as terraces or benches somewhat above the present flood plains. The topography is flat, usually with a gentle slope toward the stream. Drainage is generally good. The surface of the type lies from 20 to 25 feet below the general level of the higher terraces and from 8 to 10 feet above the flood plains. In a few places the slope is insufficient to carry off the surplus water during periods of heavy rainfall. The underdrainage is usually adequate, and water seldom stands on the type longer than a few hours.

Owing to its small extent the Waukesha very fine sandy loam is of little agricultural importance in Antelope County. It is naturally strong and fertile and well adapted to all crops common to the region. Originally it supported a luxuriant growth of prairie grasses, but at present only small patches of the virgin sod remain. Practically all the type is used for the production of corn, oats, wheat, and alfalfa. A few hogs are raised on every farm, and on some farms one or two carloads are fattened each year for the Omaha market. Cattle are raised only in sufficient numbers to supply the home meat and dairy needs.

The average yield of corn is about 40 bushels per acre, oats 35 bushels, and wheat 20 bushels. Alfalfa is fed on the farms where pro-

duced or is sold to local feeders. Wheat, the chief cash crop, is usually hauled direct from the threshing machine to the elevators.

The Waukesha very fine sandy loam is easy to handle and can be cultivated under almost any moisture conditions without serious injury. Barnyard manure is seldom applied to the land, as the wash from the adjoining upland tends to maintain its naturally high fertility.

The selling price of this land ranges from $125 to $200 an acre, depending upon improvements and location with respect to towns.

The results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Waukesha very fine sandy loam are given in the following table:

*Mechanical analyses of Waukesha very fine sandy loam.*

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 374365 | Soil, 0 to 10 inches | 0.0 | 1.6 | 1.8 | 10.7 | 29.3 | 46.7 | 9.8 |
| 374366 | Subsurface, 10 to 24 inches | .0 | 1.0 | 1.6 | 9.8 | 31.0 | 46.9 | 9.7 |
| 374367 | Subsoil, 24 to 36 inches | .0 | .0 | .7 | 9.4 | 26.6 | 49.9 | 13.3 |

WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam is a dark grayish brown friable silt loam extending to an average depth of 12 inches. It is rich in organic matter and has a smooth velvety feel. The subsoil is a brown to grayish-brown, compact silt to very fine sandy loam, which below 30 inches usually grades into a light grayish brown or yellowish-brown friable silt or silt loam. The upper subsoil is slightly compact when dry and becomes sticky and plastic when wet. It is mottled here and there with light-gray splotches and rusty iron stains. Lime concretions occur locally in the lower subsoil, but their presence is not characteristic, and the type as a whole is not calcareous within the 3-foot section. The change from soil to subsoil is rather abrupt.

Along the outer margins where this type joins the upland the surface soil has been greatly thickened by the addition of colluvial wash from the higher slopes. Here the material is a dark-brown to almost black, mellow silt loam to an average of 24 inches, where it passes abruptly into the compact brown silty clay of the upper subsoil. The yellow friable silt of the lower subsoil is not reached in the 3-foot section.

The soil profile resembles that of the Marshall silt loam. The soil has a structure similar to that of the loess but is somewhat heavier, and the subsurface stratum is more compact. In the deeper cuts along the slopes the material is similar to the loess underlying the upland.

The Waukesha silt loam is not extensive in Antelope County, although it occupies a few areas of considerable size. It occurs chiefly upon the higher terraces along the north side of the Elkhorn River, and usually borders areas of Marshall soils. One of the largest and most uniform areas contains about 3 square miles and lies northeast of Oakdale. A smaller area occupies a long narrow strip in the vicinity of Neligh. Irregular strips occur upon the lower

terraces along Cedar, St. Clair, Ives, and Giles Creeks in the southeastern part of the county.

The type has been developed on alluvial sediments deposited by streams when they were flowing at higher levels than at present. Surface wash from the adjoining uplands has also contributed to its formation, especially near the foot of the steep slopes.

The type occupies two terrace levels. The higher benches lie from 35 to 40 feet above the stream channels and from 20 to 25 feet above the low terraces. The surface of the low benches is from 8 to 10 feet above the first bottoms or flood plains. The transition between the two terrace levels and between the low terraces and flood plains is marked by a rather short steep slope, while that to the uplands is long and gradual. The surface is almost level to very gently undulating. Drainage is everywhere good but not excessive. There is usually sufficient grade even on the more nearly level areas to carry off all surplus water.

The Waukesha silt loam is a naturally fertile soil, and where it occurs in large bodies is very important agriculturally, comprising some of the most valuable land in the county. It was originally in prairie sod of the same grasses found upon the Marshall silt loam. Approximately 90 per cent of the type is under cultivation. The remainder is pasture land. All crops common to the region can be successfully grown. Corn, oats, alfalfa, rye, and wheat rank in acreage in the order named. Wheat and rye are the chief cash crops. The corn, oats, and alfalfa are fed locally to livestock. Dairying is practiced in a small way on a few farms. The milk cows are mostly of grade Hereford and Shorthorn breeds, though a few farmers have well-bred Holstein herds. Hog raising is practiced quite extensively on this type and cattle are fed on many farms during the winter. Most of the stock to be fed is shipped in from Omaha.

The average yield of corn is about 40 bushels, oats 30 to 40 bushels, rye 25 bushels, and wheat 20 bushels per acre. Alfalfa yields 3½ to 4 tons from three cuttings.

The Waukesha silt loam is handled in much the same manner as the Marshall silt loam. The type is naturally fertile, retentive of moisture, and resistant to drought. No definite crop rotation is followed. The general tendency is to grow less corn, more wheat and alfalfa, and to keep more livestock on farms of this type. Stubble land is usually plowed in the fall if time permits. Most of the corn is checkrowed. The soil is easily handled and can be cultivated under a rather wide range of moisture conditions. It has a slight tendency to clod when plowed wet, but the lumps are easily reduced. Barnyard manure is applied when available. The surface wash from the adjoining uplands helps to maintain the high fertility of the soil.

The selling price of the Waukesha silt loam ranges from $125 to $200 an acre, depending largely upon improvements and location.

### O'NEILL LOAMY FINE SAND.

The surface soil of the O'Neill loamy fine sand is a dark-brown to dark grayish brown loamy fine sand 8 to 12 inches deep. The surface layer of 6 inches is considerably darker than the lower part owing to a greater accumulation of organic matter, but as a rule the

humus content is not sufficient to keep the soil from drifting when the native vegetation is destroyed. The sand of which the soil is so largely composed is made up of nearly all grades, but the very fine sand predominates. A few small pebbles are scattered here and there upon the surface of the type. The subsoil is usually coarser than the soil, being composed largely of the fine and medium grades of sand, with some very fine sand and silt. It is gray in color and contains little or no organic matter. The change in color from surface soil to subsoil is usually rather abrupt. The type is noncalcareous throughout the 3-foot section.

A few slight variations occur in the type. Locally there is a layer of 4 to 6 inches of somewhat lighter color immediately below the soil, representing a gradation in color between the soil and subsoil. In places a layer of coarse sand and fine gravel is encountered below 30 inches. Spots are scattered throughout the type where the surface soil has been entirely removed by the wind exposing the gray sand of the subsoil. Where these were of sufficient size to warrant mapping they were included with the Plainfield sand, which differs from the O'Neill soils in this county in being lighter in color, less coherent, and lower in content of organic matter.

The O'Neill loamy fine sand has a small total area. It occurs chiefly in small, irregular-shaped bodies upon the lower terraces along the Elkhorn River. Isolated areas lie along Clearwater, Antelope, and Cedar Creeks in the southern and southwestern parts of the county. One of the largest areas lies near Clearwater.

The type has been developed from alluvial sediments deposited when the streams were flowing at higher levels. Later intrenchment by the streams left them as terraces above the present flood plains. Surface wash from the adjoining uplands and wind-blown materials from the surrounding types have also contributed to its formation.

The topography is generally flat to slightly undulating. In some areas the surface has been modified by wind action and is hummocky. Drainage is good and in a few places excessive, owing to the open structure of the subsoil.

About 80 per cent of the type is in farms and the remainder is used for grazing and hay production. The native vegetation consists of a great variety of nutritious grasses, chief among which are big bluestem, little bluestem, sand grass, stipa, and grama grass. Of the cultivated crops, corn, oats, alfalfa, and rye rank in acreage in the order named. Melons are grown for sale and home consumption on a few farms. Melon growing is becoming more important, as the numerous towns in the county afford excellent markets. The land is not so well suited to small grains as some of the heavier soils on account of its loose sandy texture.

The yields of corn range from 18 to 30 bushels, with an average of about 25 bushels per acre. The average yield of rye is about 18 bushels, oats 20 bushels, and alfalfa 2½ to 3 tons per acre. Alfalfa makes a good growth, but the stand is rarely as thick as on the Waukesha soils. The soil is not as durable and productive as the heavier soils of the terrace. It is easily tilled and has adequate drainage even in wet years, but does not withstand drought very well and is subject to more or less shifting by the wind during dry seasons.

Rye is usually drilled in on old corn or stubble ground that has been disked. The land is plowed only every second or third year. Corn is usually listed in, as it withstands drought better and the young plants are not so subject to injury by the wind as when check planted. Manure and straw are applied when available, as they increase the fertility of the soil and tend to make it more stable.

The price of this land ranges from $40 to $75 an acre, depending upon improvements and location with respect to towns.

### O'NEILL FINE SANDY LOAM.

The surface soil of the O'Neill fine sandy loam is a dark grayish brown, loose, friable fine sandy loam, rich in organic matter, 8 to 12 inches deep. In some places the soil approaches a loamy fine sand in texture. The upper subsoil is a loose, rather incoherent loamy fine sand to sandy loam of grayish-brown color. At 16 or 18 inches the material changes rather abruptly to a loose, incoherent, grayish-brown to yellowish-brown sand containing an abundance of coarse sand and fine gravel, which continues throughout the 3-foot section. Neither the soil nor the subsoil is calcareous.

In a few places the loamy fine sand of the upper subsoil is absent and the surface soil is underlain by a gray fine sand containing very little coarse sand or fine gravel, and coarser materials may occur below 30 inches. In other places the coarse sand and gravel is not reached within the 3-foot section, the subsoil being a loose, rather incoherent loamy fine sand to sandy loam. These variations are of such small extent and scattered occurrence that it was not feasible to show them on the map.

The O'Neill fine sandy loam has a total area in the county of less than 5 square miles. It occurs chiefly in small scattering bodies upon the terraces bordering the Elkhorn River in the southeastern and west-central parts of the county, with isolated areas along the branches of Verdigris Creek and along Bazile Creek in the northern part. The largest area, containing about 2 square miles, lies on the south side of the Elkhorn River, a short distance northwest of Tilden.

The type represents alluvial deposits laid down when the streams were flowing at higher levels. The topography is flat to very gently undulating, with a slight slope toward the stream axis. Drainage is everywhere good, as there is usually sufficient slope to carry off the surplus water and the loose porous soil and subsoil insure excellent underdrainage.

The O'Neill fine sandy loam is a fair farming soil and during normal years produces good yields of all crops common to the region. About 85 per cent of it is under cultivation, the rest being used for pasture and hay land. The native vegetation consists of grama, buffalo, bluestem, and a small proportion of stipa and sand grass.

Of the cultivated crops, corn, oats, alfalfa, and rye are the most important. The yields are somewhat lower than those obtained on the heavier, more calcareous soils, chiefly on account of the slightly droughty nature of this type. The average yield of corn is about 25 bushels, oats 30 bushels, rye 18 bushels, and alfalfa 2½ to 3 tons per acre. Native hay yields one-half to three-fourths ton per acre, depending upon the rainfall. The grasses will support 300 to 320 head of cattle per square mile during the summer grazing season.

Rye is the chief cash crop and is usually hauled to local elevators direct from the threshing machines. Most of the corn, oats, and alfalfa is fed to cattle, hogs, and work stock on the farms where produced. Hog raising is becoming an important industry, as the land is better adapted to corn than to the other grain crops. Most of the cattle are native stock, though some are brought in for summer grazing and shipped in the fall as feeders to the Omaha market.

The soil is handled in much the same manner as the O'Neill loamy fine sand. Much of the corn, however, is check planted, as the soil is more stable and there is less danger of blowing. Barnyard manure and straw are applied when available. The manure is usually spread in the fall or early spring.

The selling price of the O'Neill fine sandy loam ranges from $50 to $125 an acre, depending largely upon improvements and location.

### PLAINFIELD SAND.

The surface soil of the Plainfield sand is a grayish-brown to dark grayish brown, loose, incoherent sand 8 to 10 inches deep. The upper 6 inches is slightly darker than the lower part, owing to the presence of a small amount of organic matter, but there is not enough of this material to prevent the soil from drifting where left without vegetative protection. The sand consists of about equal parts of the medium, fine, and very fine grades. The upper subsoil is a light grayish brown or yellowish-brown medium sand containing very little organic matter. Below 18 inches the subsoil is a loose, incoherent gray sand, usually considerably coarser than that of the soil and upper subsoil, which extends below the 3-foot section. Both soil and subsoil are noncalcareous. The type differs from the O'Neill soils chiefly in the lower content of organic matter and lighter color of the surface soil.

The Plainfield sand occupies a few small areas upon the terraces on the south side of the Elkhorn River. The largest area lies near the mouth of Antelope Creek. The soil has been derived largely from alluvial sands deposited in a former flood plain of the stream. Wind-blown sands from the adjoining Valentine and Dunesand areas have also undoubtedly contributed to its formation.

The topography is flat to very gently undulating, modified in a few places by low rounded sand hummocks and ridges. There is a gradual slope down the valley and toward the stream. Both surface and internal drainage are good, the latter sometimes being excessive on account of the porous nature of the subsoil. Crops sometimes suffer from lack of moisture during prolonged droughts.

The Plainfield sand is not an important farming soil on account of its low water-retaining capacity and the danger of blowing when not carefully managed. About 40 per cent of it is under cultivation and the remainder is used for pasture and hay land. The native vegetation consists of sand grass, grama grass, and bluestem. Corn is the chief cultivated crop. Very little small grain is grown on account of the injury sustained by the young plants during dry windy weather. Watermelons and cantaloupes are raised on a few farms. The soil seems well adapted to these crops in years of normal rainfall, but in

dry seasons the soil moisture is insufficient for best results. Beef cattle are grazed on the areas not under cultivation. Hereford and Shorthorn are the principal breeds. Most of the cattle are native, though a few ranchers ship in stock for summer grazing. Hogs are raised on nearly every farm, are fattened on corn, and shipped to the Omaha market. Cattle feeding is not practiced extensively, although a few farmers fatten one or two carloads each winter.

The grasses on this type will support 100 to 200 head of cattle per square mile during the summer season, or when cut for hay will yield 300 to 400 tons, depending upon the rainfall. Corn yields 18 to 20 bushels per acre, but during dry years the grain sometimes fails to mature.

The prime needs of this soil are to prevent wind erosion and increase the water-holding capacity through the addition of organic matter. The plowing under of vegetation, large applications of manure, and careful tillage should greatly increase the productive power of the type. It is not advisable to bring more of this soil under cultivation unless it is to be very carefully managed. Careless cultivation soon destroys the naturally low content of organic matter and allows the soil to blow badly.

### SIOUX LOAMY SAND.

The surface soil of the Sioux loamy sand is a brown to dark grayish brown, loose, loamy sand, 8 to 12 inches deep. The sand of which the soil is so largely composed is made up of the medium, fine, and very fine grades, with the fine sand predominating. The silt and clay content is low, being insufficient to prevent the soil from drifting when the native sod is destroyed. The upper subsoil to an average depth of 20 inches differs little in texture from the surface material, but is of slightly lighter color because of a lower humus content. The lower subsoil becomes gradually lighter in color and texture with depth, and below 24 inches usually consists of a light-gray to almost white fine to medium sand. In places a layer of coarse sand and fine gravel is encountered below 30 inches. In the more poorly drained situations the lower subsoil is sometimes faintly mottled with rusty-brown iron stains. On the higher situations and rounded hummocks the light-colored sand of the subsoil comes closer to the surface, while in depressions and flat areas the organic content extends below the 3-foot section. The surface soil is not highly calcareous, but the entire subsoil has a high lime content. The type differs from the O'Neill soils chiefly in the calcareous nature of its subsoil.

The Sioux loamy sand has a total area in Antelope County of less than 6 square miles. It occurs on the low terraces along the south side of the Elkhorn River. The greater part of the type is included in one large area lying west of Clearwater. A smaller area lies on the west side of Antelope Creek in the vicinity of Neligh. The type represents alluvial materials deposited on a former flood plain, which now lies above the present bottom lands. Wind-blown materials from the adjoining Valentine soils, together with sands blown from the flood plains, have also contributed to the formation of the type.

The surface is generally flat, although slightly relieved by low ridges, knobs, and shallow depressions. The type lies somewhat below the general level of the O'Neill series and from 12 to 15 feet above

the stream. It is for the most part fairly well drained. There are rather extensive areas, however, especially around the outer margins, where in wet years drainage is poor because of seepage water from the higher lying Valentine soils.

Owing to its small extent and uncertain drainage, the type is of little agricultural importance. It is used for pasture land and hay production, and includes some of the best native hay land in the county. It supports a luxuriant growth of grama grass, sand grass, and bluestem, which will support from 100 to 150 head of cattle per square mile during the summer grazing season, or when cut for hay will yield three-fourths to 1 ton per acre, depending upon the rainfall. Most of the cattle on this type are native stock, although a few are shipped in for summer grazing. The hay is usually stacked in the field for winter feeding, though a small part is baled for shipment to outside markets.

Land of the Sioux loamy sand sells for $75 to $125 an acre, depending upon improvements, location, and drainage.

### SIOUX FINE SANDY LOAM.

The surface soil of the Sioux fine sandy loam has an average depth of 10 inches and is a dark grayish brown to almost black, loose, friable, fine sandy loam containing a relatively large proportion of medium sand. The upper subsoil is a brown to light-brown loamy fine sand extending to an average depth of 20 inches. Below this the material becomes gradually lighter in color and coarser in texture and at 24 inches usually is a gray to light-gray, loose, incoherent fine to medium sand which extends below the 3-foot section. Coarse sand and fine gravel are encountered in places below 30 inches. In the more poorly drained situations the lower subsoil is faintly mottled in places with rusty iron stains. The depth of the surface soil varies considerably, depending upon the location. On the low knobs and ridges it is usually rather shallow, and the gray sand is reached at a depth of 12 inches. In the flatter areas the gray sand sometimes lies below the 3-foot section. The humus content gradually decreases with depth, and over most of the type is nearly absent below 30 inches. The surface soil is only faintly calcareous. The subsoil, however, contains much lime in finely powdered form.

The Sioux fine sandy loam occurs chiefly in a few small isolated areas bordering the Elkhorn River flood plains. One of the largest areas, comprising about 200 acres, is at Clearwater. A typical area lies southwest of Neligh. A small area is mapped on the north side of Clearwater Creek in the central part of Clearwater Township. The type has been developed on former flood-plain material through extensive weathering and the accumulation of organic matter.

The topography for the most part is flat, modified by low rounded knobs and shallow depressions. The type lies somewhat below the general level of the adjoining terrace soils and is in many places poorly drained, owing to the accumulation of seepage water from the higher levels. The porous subsoil, however, speedily absorbs the surplus moisture, so that water seldom remains on the surface longer than a few hours.

Owing to its small extent and uncertain drainage the type is of little importance agriculturally. It is used almost exclusively for

hay production. The native grasses, including grama, bluestem, and sand grass, make rank growths and yield from three-fourths to 1 ton of hay per acre. All of the hay is fed locally to cattle and work stock.

### WABASH VERY FINE SANDY LOAM.

The surface soil of the Wabash very fine sandy loam is a dark-brown to almost black, mellow, very fine sandy loam having an average depth of 10 inches. The material is composed of about equal proportions of silt and very fine sand, very little of the medium or coarser grades of sand, and much organic matter. The subsoil is slightly lighter in color than the surface soil, is rather compact, and ranges in texture from a very fine sandy loam to silt loam. In places it contains faint gray and brown mottlings below 24 inches. The subsoil is not usually calcareous, although below an average depth of 4 feet the substratum in many places changes abruptly to a light-gray, loose, floury silt or silty clay which is rich in lime.

The type includes small patches of typical silt loam, but owing to their irregular and inextensive occurrence they were not separated on the soil map.

The Wabash very fine sandy loam has a total area of about 2½ square miles. It occupies a few isolated bodies and narrow strips along the Elkhorn River and Cedar, Willow, and Bazile Creeks. The type represents alluvial sediments which have been carried down by the streams from the adjoining uplands and deposited along their channels during flood stages. Colluvial wash from the higher lying and coarser textured soils has been largely responsible for the very fine sand content of this type.

The surface is practically flat except where modified by old stream channels, cut-offs, and shallow depressions. There is usually a gentle slope down the valley and toward the streams. Drainage is adequate for crop production except in local depressions. The type lies from 4 to 6 feet above the normal flow of streams. It is subject to occasional inundations, but water seldom stands on the surface longer than a few hours.

Owing to its small extent, the Wabash very fine sandy loam is of little agricultural importance in Antelope County. Originally it was covered with a luxuriant growth of prairie grasses, except along the margins of streams, where it supported a fairly dense stand of mixed timber, including elm, boxelder, ash, cottonwood, and hackberry. At present all but about 10 per cent of the type has been broken for crop production. The virgin areas are used for pasture land and wood lots. Corn, wheat, oats, and alfalfa are the leading crops, ranking in acreage in the order named. Small patches of rye, millet, potatoes, and garden vegetables are grown to supply the home needs.

The yields of all crops compare very favorably with those obtained upon the Wabash silt loam. The soil is easy to handle and can be cultivated under a wide range of moisture conditions. It is naturally strong and fertile and is highly prized for general farming. Manure is seldom applied to the land. The type receives sufficient wash from the adjoining uplands and from sediments deposited during floods to maintain its high fertility.

The selling price of this type ranges from $75 to $150 an acre, depending upon drainage, improvements, and location.

### WABASH SILT LOAM.

The surface soil of the Wabash silt loam is a dark-brown to black friable silt loam, 10 to 15 inches deep, which contains large quantities of organic matter and in a few places a relatively large percentage of very fine sand. The upper subsoil is a black silty clay loam of more compact structure than the surface soil. When wet it is slightly plastic and sticky; when dry it breaks down into granules. Faint brown mottlings are encountered locally below 30 inches. Ditches on this type show that between the depths of 4 and 5 feet the substratum passes into a light-gray silt loam that is streaked and blotched with reddish iron stains and contains lime concretions. In poorly drained areas light-gray mottlings usually occur in the lower subsoil.

In the narrower stream valleys and in a few places on the wider bottoms the soil section shows little or no change in color or texture to the 3-foot depth, except that the material below 24 inches becomes slightly more compact. In these localities the soil is a smooth dark-brown silt loam, underlain by a dark-brown more compact silt loam. Locally the lower subsoil is a gray silt or silty clay resembling the lower subsoil of the Waukesha series. Where the light-colored material was encountered above the 24-inch depth, the soil was included with the Waukesha silt loam.

The Wabash silt loam is not extensive in Antelope County. It is confined to the first bottoms along the larger creeks flowing through areas of Marshall silt loam. It occupies narrow continuous strips varying in width from one-eighth to three-fourths mile along Giles, Ives, St. Clair, and Cedar Creeks. The largest development borders Ives Creek southwest of the Bunker Hill School. A small but very uniform body lies within the town of Tilden on Giles Creek.

The material composing the type is of alluvial origin, having been washed from the adjoining uplands, carried by the streams, and deposited within the present flood plains. The decay of the rank vegetation developed under moist conditions accounts for the dark color and high content of organic matter. The flood plains of some of the smaller tributaries are narrow and in places a slight exaggeration was necessary to show them on the soil map.

The topography is generally flat, modified in many places by old cut-offs, stream channels, and shallow depressions. The surface lies from 4 to 6 feet above the streams and is overflowed only during seasons of heavy rainfall. There is usually sufficient slope down the valley and toward the stream axis to carry off the surplus water. In a few places, however, the compact subsoil prevents underdrainage, so that during wet seasons water accumulates in shallow depressions, giving rise to considerable areas of poorly drained soil.

The Wabash silt loam is unimportant chiefly on account of its small extent. It is very strong and fertile and withstands drought as well as any other type in the area. About 85 per cent of it is under cultivation and the remainder, including the poorly drained areas, is in pasture and woodlots. Originally the greater part of the type was covered with a luxuriant growth of prairie grasses, with narrow strips of forest along the streams. Much of the timber still remains, though large quantities have been cut for fuel. The present tree

growth consists of elm, ash, cottonwood, hackberry, and boxelder. On the cultivated areas, corn, oats, wheat, and alfalfa are the leading crops. The livestock industry is well developed and consists largely of hog raising and winter fattening of steers.

The type is considered one of the most productive soils in the county. Crop yields are usually 10 to 15 per cent higher than on the adjoining upland soils. Corn, the dominant crop, yields from 45 to 65 bushels per acre in good years. On well-managed fields 70 to 80 bushels are often obtained. The average yield of wheat ranges from 20 to 25 bushels. During wet seasons wheat sometimes lodges and the yield is materially reduced. Kherson oats, a short stiff-stemmed variety, does well on this type, yielding 35 to 50 bushels per acre. The long-strawed oats are likely to lodge. Alfalfa does well on all but the more poorly drained parts, and during normal years three or four cuttings are obtained with a total yield of 4 to 5 tons per acre. It makes a more luxuriant growth on this type than on any other soil in the county. The native grasses on each acre of the soil will support a cow or horse during the summer grazing season, or when cut for hay will yield from 1 ton to 1¼ tons. Timothy and clover do well in wet seasons, yielding from 1½ to 3 tons of hay per acre. Potatoes and other garden vegetables are grown for home use.

Crop rotation is given little attention. The soil is quite easy to handle and can be cultivated under a rather wide range of moisture conditions. If plowed when wet, it forms clods, but these are easily reduced. Manure is seldom applied, as with proper management it is not needed. The addition of silt washed down from the adjoining uplands helps to maintain the soil in a productive condition.

The price of land of the Wabash silt loam type is $75 to $150 an acre, depending upon its drainage and location.

### LAMOURE VERY FINE SANDY LOAM.

The surface soil of the Lamoure very fine sandy loam is a black very fine sandy loam, 8 to 14 inches deep, which contains a relatively large proportion of silt and very little material coarser than fine sand. The upper subsoil is a slightly lighter colored and more compact very fine sandy loam extending to an average depth of 20 inches, where it passes rather abruptly into a gray or dark-gray heavy silt loam containing a relatively large percentage of clay. The lower subsoil is sticky and plastic when wet but becomes hard and brittle upon drying. The surface soil is usually slightly calcareous, and the subsoil has a high lime content.

Mapped with this type are three small bodies in which the surface material approaches a fine sandy loam in texture. Two of these occur in Ord Township, being parts of the large area located near the mouth of Clearwater Creek, and the other lies southwest of Neligh on the north side of the Elkhorn River. These areas differ from the typical soil only in the coarser texture of the surface soil, which contains a larger percentage of fine and medium sand than the very fine sandy loam type.

The Lamoure very fine sandy loam is confined to a few small bodies along the Elkhorn River in the central part, and along Willow Creek in the east-central part of the county. The largest area lies one-half mile southeast of Clearwater. A small body lies on the north side of the river in section 11 of Ord Township.

The topography is prevailingly flat, modified in a few places by shallow depressions and stream channels. Drainage is poor. The type lies only a few feet above the normal flow of the streams and is either subject to frequent overflow from the main channels or to the accumulation of seepage waters from the higher lying soils.

Owing to its small extent and poor drainage the type is not used for crop production but is all included in pasture and hay land. The native vegetation is composed largely of coarse marsh grasses, together with sedges and reeds in the more poorly drained places. Timothy and clover have become fairly well established over parts of this type, largely from seed washed down from Wheeler County farther west, where the early ranchers planted these crops extensively in an effort to improve the feeding value of the native range grasses.

The grasses of this type will support one cow or horse per acre during the summer grazing season, or when cut for hay will yield 1 ton to 1½ tons. The hay is coarser than that obtained on the better drained soils and has a somewhat lower feeding value. All of the hay is stacked in the field and fed to cattle and horses during the winter months.

The primary need of this type is artificial drainage. A system of deep drainage ditches or tiling would greatly increase the producing power of the soil.

### LAMOURE SILT LOAM.

The surface soil of the Lamoure silt loam is a very dark grayish brown to almost black heavy silt loam, 12 to 14 inches deep, which contains a high percentage of clay and in places approaches a silty clay loam in texture. The soil is high in organic matter and appears jet black when wet. The upper subsoil is slightly more compact than the surface soil and consists of a gray, heavy silt loam or silty clay loam. The lower subsoil below 20 inches is a heavy, rather compact silty clay to clay of light-gray color, mottled in places with dark-gray splotches and rusty iron stains. The type is usually calcareous throughout the 3-foot section. The lime increases with depth and in the lower subsoil consists of angular concretions from one-sixteenth to one-eighth inch in diameter. This type differs from the Wabash silt loam chiefly in the calcareous nature of its subsoil.

In some very small areas a loose porous sand is encountered below an average depth of 32 inches. Included with this type are two small areas of Lamoure silty clay loam. They lie across the line between sections 2 and 11 of Ord Township. These areas differ from the silt loam only in the higher clay content and consequently heavier and more plastic nature of the surface soil.

The Lamoure silt loam is confined chiefly to a few small bodies along the Elkhorn River and a rather extensive area along Willow Creek. A small area is also mapped in section 36 of Bazile Township and section 1, Crawford Township.

The type consists of recent alluvium deposited upon the present flood plains. The topography is prevailingly flat, modified in a few places by shallow depressions, old cut-offs, and stream channels. Drainage is poor. The type lies but a few feet above the normal flow of the streams and is subject to frequent overflow. Large areas remain in a marshy condition the greater part of each year. The restricted natural drainage probably accounts for the concentration of calcium carbonate in the subsoil.

Owing to its small extent and poor drainage the type is of little agricultural importance in Antelope County and is all included in pasture and hay land. The native vegetation consists of a great variety of water-loving grasses, with some volunteer timothy and clover. These grasses will support one cow or horse per acre during the summer grazing season or when cut for hay will yield 1 ton to 1¼ tons. Most of the hay is stacked for winter feeding, although a few farmers bale the hay for shipment outside the county. The hay on this type is somewhat coarser than that of the upland soils and has a lower market value.

The principal need of this soil is better drainage, which can be provided by a system of deep drainage ditches or by tiling. When drained, the soil is as productive as the Wabash silt loam, and its productiveness can be maintained by growing alfalfa or clover in rotations.

### CASS LOAMY FINE SAND.

The surface soil of the Cass loamy fine sand is a brown to very dark brown loose fine sand, 8 to 10 inches deep. It contains a relatively large proportion of well-decomposed organic matter, which gives it a dark color and loamy texture, but is not sufficient to prevent soil blowing during prolonged droughts if the native vegetation is destroyed. The sand of the soil consists mainly of the fine and very fine grades. The upper subsoil is a lighter brown fine sand, grading at about 20 inches into a gray, loose, incoherent fine to medium sand. The subsoil is very deficient in organic matter and the entire soil section is usually not highly calcareous.

A few minor variations were included with this type. In places the subsoil below 30 inches is composed of coarse sand and fine gravel. In other more poorly drained areas rusty-brown mottlings are encountered throughout the subsoil and the material in places is slightly compact owing to a small proportion of clay mixed with the sand. Locally the lower subsoil is calcareous. The most important variations in the surface soil are toward a fine sandy loam, where conditions have been especially favorable for the growth and decay of plant life, and toward a sand in the more exposed situations where much of the organic matter has been removed by the wind. In many places adjacent to the stream channels the surface soil is almost pure sand of such recent deposition that organic matter has not accumulated.

The type is not extensive in Antelope County. It occurs chiefly in scattered areas on the flood plains of the Elkhorn River. Narrow strips were mapped along Clearwater and Antelope Creeks and some of the larger tributaries of Verdigris Creek. The individual bodies are small, elongated in outline, and roughly parallel to the present or abandoned channels. One of the largest and most uniform areas borders the Elkhorn River in sections 11, 12, and 13 of Ord Township. Another typical development lies on the south side of the river in section 20 of Frenchtown Township.

The type has been developed on recent alluvium carried by the streams from the adjacent uplands and from regions farther west and deposited on their flood plains. Wind-blown sands have also added considerable material. The growth and decay of plant life has been largely responsible for the dark color and loamy character of the surface soil.

The surface is flat, modified in places by numerous depressions, dry channels, and slight elevations. The greater part of the type has adequate surface and internal drainage. In extensive areas, however, the water table lies only 1 or 2 feet below the surface, so that crops can not be profitably grown. During extremely dry years the underdrainage is excessive in places and crops suffer from lack of moisture.

The Cass loamy fine sand is an unimportant agricultural soil in Antelope County, both on account of its small extent and uncertain drainage. About 60 per cent of it is under cultivation, and the remainder, including the poorly drained areas, is used for pasture and hay land. The native vegetation is the same as that on the Cass fine sandy loam and very fine sandy loam types. Corn is the leading cultivated crop, followed by oats and alfalfa. The acreage devoted to small grain is rather small. Alfalfa does not do well where the water table lies near the surface. Hog raising is important on those parts of the type where alfalfa can be successfully grown. The raising of beef cattle is not practiced extensively, although many farmers graze stock where enough of the poorly drained land is available for pasture. A few cattle are fed for the Omaha market.

The average yield of corn is about 30 bushels in favorable years; in dry seasons it is considerably less. Oats yield 20 to 30 bushels, and alfalfa yields 1½ to 2 tons per acre from three cuttings. Native hay yields three-fourths to 1 ton per acre. The grasses will support from 60 to 80 head of cattle per quarter section during the summer grazing season.

The land sells for $25 to $75 an acre, depending upon drainage, improvements, and location with respect to markets.

The soil of this type should be very carefully handled to maintain and increase the humus content. Heavy applications of barnyard manure and increased acreage of leguminous crops, such as clover and alfalfa, would increase the productive power of the land. The poorly drained areas should be ditched or tiled.

### CASS FINE SANDY LOAM.

The Cass fine sandy loam is a brown to dark-brown fine sandy loam, 8 to 12 inches deep. It contains a relatively large percentage of coarse and medium sand. The upper subsoil is a gray or grayish-brown loamy fine sand, loose in structure. The lower subsoil below 20 inches consists of gray, incoherent fine sand, which gradually becomes coarser with depth, changing at about 30 inches into coarse sand and fine gravel. The surface layer of 6 inches is generally well supplied with organic matter, and it contains sufficient calcium carbonate to effervesce slightly with acid. The lower subsoil is not highly calcareous. Rusty-brown iron stains are encountered below 24 inches.

The principal variation in texture from the typical soil is toward a very fine sandy loam. In many places there is only a thin layer of soil high in organic matter, underlain by yellowish-gray incoherent sand. In a few of the lower situations the dark-colored fine sandy loam is underlain at 12 to 15 inches by gray, medium to coarse sand, which extends below the 3-foot depth. In some small areas there is an intermediate subsoil layer of coarse sand and fine gravel, underlain by the incoherent sand of the typical subsoil.

The Cass fine sandy loam is the most extensive bottom-land soil in the county. It occurs in small bodies and narrow strips within the flood plains of the Elkhorn River and the larger creeks throughout the more sandy sections. The areas are usually elongated and lie more or less parallel to the present and old stream channels. They vary in size from a few acres to about 1 square mile. One of the largest lies along the north side of the river between Tilden and Oakdale, and another is between Oakdale and Neligh. A smaller area lies north of Clearwater on the south side of the river. Narrow broken strips border the channels of Clearwater, Antelope, and Willow Creeks, the South and East Branches of Verdigris Creek, and Bazile Creek.

The type is developed upon flood-plain material deposited by the streams during comparatively recent times. Subsequent weathering and the accumulation of organic matter has greatly modified the surface of the original deposit.

The topography is generally flat, modified in places by slight depressions and abandoned channels. The surface lies from 6 to 8 feet above the normal flow of the streams and is not often subject to inundation. Drainage over most of the type is sufficient for profitable farming in average years, but in wet years the water level frequently comes within 3 feet or less of the surface, and even in normal years extensive bodies remain too moist for successful farming. In very dry years the underdrainage is excessive, and corn especially may not do so well as on types with heavier subsoils.

The Cass fine sandy loam is unimportant in Antelope County, chiefly on account of its uncertain drainage conditions. About 60 per cent of it is under cultivation, and the rest is used for pasture land and hay production. The native vegetation includes a great variety of prairie and water-loving grasses, with some volunteer timothy and clover. Narrow strips of timber border the stream channels. The trees consist of elm, ash, willow, and cottonwood, with some hackberry and linden. On the cultivated areas corn, oats, and alfalfa are grown. The type is not well adapted to small grain because it is difficult to obtain a firm seed bed, and during exceptionally dry years the soil is subject to more or less drifting, with consequent injury to small-grain crops. Watermelons and muskmelons are raised to a small extent, as the soil is porous and warms up early in the spring. A few hogs are raised on every farm, and cattle are grazed on farms that contain enough poorly drained land for pasture.

The average yield of corn is 35 bushels, oats 30 bushels, and alfalfa 2 to 2½ tons from three cuttings. Native hay yields three-quarters to 1 ton per acre. Definite statements of yields of truck crops were not obtainable, as the trucking industry is new and accurate records have not been kept.

The Cass fine sandy loam can be easily handled under a wide range of moisture conditions with lighter machinery and less power than is required for the heavier soils of the county. Corn is usually listed in, and small grain is planted with a press drill on well-prepared corn or stubble ground. Barnyard manure is applied when available. Commercial fertilizers are not used even for truck crops.

The selling price of the Cass fine sandy loam ranges from $100 to $150 an acre, depending upon improvements, location, and drainage.

CASS VERY FINE SANDY LOAM.

The surface soil of the Cass very fine sandy loam is a dark grayish brown very fine sandy loam, 8 to 10 inches deep, with a relatively large proportion of silt and very little material coarser than very fine sand. The subsoil consists of a brownish-gray fine to very fine sand, grading at about 24 inches into a gray or grayish-brown, loose, incoherent fine sand, which usually gives way to a layer of coarse sand and gravel below 30 inches. In many places the lower subsoil is mottled with faint rusty brown streaks due to poor drainage.

A few variations are included in the type. In many places the subsoil is made up of alternating layers of very fine sand, silt, and clay, the sand predominating. Locally the subsoil below 8 inches is a gray to almost white, fine to medium sand, which may continue to the 3-foot depth or may be underlain at about 30 inches by a stratum of silt loam or very fine sandy loam. A few bodies of Cass fine sandy loam too small to be shown on the map are included with this type. In local patches seldom exceeding an acre in extent the surface soil is a dark-brown to black, friable loam, 8 to 12 inches deep, and the subsoil is a light-brown very fine sandy loam often tinged with yellow.

The Cass very fine sandy loam occupies small bodies and narrow strips upon the present flood plains bordering Clearwater, Willow, and Bazile Creeks. Generally it is closely associated with the Cass fine sandy loam and loamy fine sand types, but in many places along the Elkhorn River the Cass very fine sandy loam lies adjacent to the terraces or upland, while the coarser textured types lie nearer the stream channel. One of the largest bodies, comprising an area of about 1½ square miles, extends across the eastern county line along Willow Creek. A smaller area lies just north of Tilden along both sides of the river. The type is the chief bottom-land soil along the east branch of Bazile Creek in the northeastern part of the county.

The soil has weathered from recent alluvium transported from the uplands by the streams and deposited in the present flood plains. The organic content has probably been considerably increased by subsequent growth and decay of plant life.

The topography is prevailingly flat, except where relieved by old stream channels, sloughs, and low ridges. The type as a whole is poorly drained. The surface lies only a few feet above the normal flow of the streams and is subject to frequent inundations. The porous subsoil absorbs the surplus surface moisture over the greater part of the type, but is so near the water table that it remains in a wet condition the greater part of the year. In a few places intermittent streams carrying water from the uplands spread out over parts of the type, creating extensive areas of marshy land.

The Cass very fine sandy loam is an unimportant type in this county, chiefly because of its poor drainage. About 90 per cent of it is included in pasture and hay land. The remainder, comprising the better-drained areas, is used for crop production. The native vegetation consists of a great variety of prairie and swamp grasses, together with considerable volunteer clover and timothy. Narrow strips of forest border the stream channels. The grazing of beef cattle is the chief industry, although hogs are raised on many farms. The native grasses will support from 150 to 175 cattle per square mile during the summer grazing season, or when cut for hay will yield three-

fourths ton to 1¼ tons per acre. Most of the hay is stacked for winter feeding, and some is baled for shipment. The principal cultivated crops are corn, oats, wheat, and alfalfa. Where the drainage is sufficient, the crop yields on this type are usually good. The average yield of corn is about 40 bushels, oats 40 to 45 bushels, wheat 20 to 25 bushels, and alfalfa 2½ to 3 tons per acre. Alfalfa does well and its acreage is increasing.

Manure is applied when available, but crop rotation is not systematically practiced. The type can be cultivated soon after heavy rains without serious injury, and is one of the first soils to warm up in the spring. It is well adapted to fruits and vegetables, though these receive very little attention.

The selling price of the Cass very fine sandy loam ranges from $25 to $75 an acre, depending largely upon improvements, drainage, and adaptability to grain production.

### SARPY SAND.

The surface soil of the Sarpy sand consists of a gray to light grayish brown, loose, incoherent sand, underlain by material of the same texture and structure to below a depth of 3 feet. The surface soil is usually slightly darker than the rest of the soil section, owing to a small amount of organic matter. Locally the subsoil below 30 inches is mottled with rusty iron stains, indicating poor drainage. In a few places the lower subsoil is almost white, and below 24 inches is composed of a loose mixture of coarse sand and fine gravel. The type differs from the Cass loamy fine sand in the coarser texture, lower content of organic matter, and lighter color of the surface soil.

The Sarpy sand occupies numerous small bodies and narrow strips adjacent to the Elkhorn River throughout its distance across the county. Narrow strips were also mapped along the South Branch of Verdigris Creek and its larger tributaries. One of the largest areas, containing about 1 square mile, lies north of Oakdale. Many areas of the type lie between old cut-off channels and the present stream. The material represents recent alluvium which has not yet developed a dark-colored surface soil from growth and decay of vegetation. In many places the material resembles Riverwash, but is more stable and not so greatly influenced by each slight rise of the stream.

The topography is flat, modified in places by old cut-offs, depressions, and slight elevations, the latter being caused by wind, which in the more exposed situations whips the sand into low rounded knolls and ridges. The surface of the type lies from 4 to 8 feet above the normal flow of the stream. Most of the land is subject to occasional inundations. In dry years the internal drainage is excessive, and vegetation sometimes suffers from lack of moisture. In wet years, however, the water table often lies within the 3-foot depth and in the lower lying situations water accumulates on the surface, making large areas of little value.

The Sarpy sand is not used for crop production but is included in pasture and hay land. The native vegetation is sparse and does not have a high value even for pasture. Narrow strips of forest, including a fairly dense growth of ash, elm, cottonwood, and willow, occur along the streams. In a few places the subsoil material is used for building purposes. Land of this type tends to lower the price of farms in which it is included.

It is doubtful if any of the Sarpy sand should be used for crop production, as it blows badly when disturbed, is rather droughty, and is subject to occasional inundation. The seeding of tame grasses, such as timothy and alsike in the poorly drained areas, and sand grasses on the more exposed positions, would greatly increase the grazing value.

### DUNESAND.

Dunesand consists of a gray or grayish-brown, smooth, incoherent, fine to medium sand which extends to a depth of more than 3 feet with little change in texture. The surface material contains some organic matter but not enough to prevent drifting when the covering of grasses is removed. The soil on the ridges is usually lighter in color than that in the hollows because of a lower organic content. The type is quite retentive of moisture, considering its loose texture. Neither the soil nor subsoil is calcareous.

Dunesand occurs chiefly as a broad strip on the south side of the Elkhorn River between Clearwater and Oakdale. This strip is not uniform throughout, but includes many depressional areas of other soils. Smaller areas, seldom exceeding 3 square miles, occur scattered throughout Lincoln, Stanton, and Elgin Townships in the southwestern part of the county.

The topography of the Dunesand is due to wind action. The surface is sharply rolling, ridged, and heaped into dunes varying in height from 30 to 60 feet. Steep slopes abound. Numerous small hummocks, hollows, and blow-outs vary the otherwise billowy appearance of the landscape. Most of the blow-outs are on the northwest exposures and a few on the southwest side of the dunes. A small part of the Dunesand is at present subject to active wind erosion. There is practically no surface drainage, but all the rainfall is absorbed by the porous substratum.

Dunesand has no value for farming. Isolated patches have been cultivated, but the soil is so subject to blowing that the removal of the native vegetation ruins the land. It is used almost exclusively for pasture, although some depressional areas are cut for hay. The native vegetation includes a great number of grasses, of which bluestem, long-leafed reed grass, redfieldia, and stipa are the most common. These afford good grazing during the spring and summer, but are killed by frost. They are capable of maintaining 100 to 150 head of stock to the section. Native hay yields one-fourth to three-fourths ton per acre, depending upon the rainfall. The selling price of the Dunesand ranges from $20 to $50 an acre.

The preservation of the native grasses is essential to the utilization of this type. Patches or slashes along old roads and near watering tanks, where the wind has had an opportunity to work on the bare surface, plainly show the disastrous effects of disturbing the soil-binding roots. Care must be taken to control fires, which burn off the protective covering of grasses.

### RIVERWASH.

Riverwash occurs in a few small areas adjacent to the channel of the Elkhorn River. The individual bodies are small and vary in size from about 10 to 100 acres. The material consists of a mixture of light-yellow, fine, medium, and coarse sands with some very coarse

sand and gravel. It occupies alternating sand bars and sand flats lying a few feet above the normal flow of the river, and is subject to frequent inundation.

Riverwash is not permanent, and the material undergoes change with each overflow. Even during normal flow small areas are shifted about, added to, or destroyed by the varying current. The material is also modified to a considerable extent by the wind. Riverwash supports a scant vegetation and is all included in pasture land. It is undergoing changes from weathering and will ultimately be developed into soils similar to the other bottom-land types.

## SUMMARY.

Antelope County is in the northeastern part of Nebraska. It is rectangular in outline and comprises an area of 864 square miles or 552,960 acres. The topography ranges from almost flat through rolling and steeply rolling to hilly and extremely dissected. The greatest relief occurs in the northwestern part. The more level areas lie upon the high divides in the southeastern part and in the large basin-like depressions of Valentine soils throughout the more sandy parts of the upland. The alluvial lands have a generally flat topography.

The greater part of the county is drained by the Elkhorn River and its tributaries. A small area in the east-central part drains eastward through Willow Creek. The northern tier of townships drain to the north through Verdigris and Bazile Creeks. The river, creeks, and intermittent drainage ways afford ample drainage for most of the county. Surface drainage is not well established in the sandy upland belt throughout the southwestern and north-central parts, but the internal drainage is thorough on account of the loose, porous nature of the sand sheet covering this region. The most imperfectly drained areas are in local depressions scattered throughout the upland and in the first bottoms along the Elkhorn River and Willow Creek.

Well water of excellent quality is readily obtained in all parts of the county.

Native timber occurs in narrow belts along all the larger streams. It consists chiefly of elm, ash, boxelder, cottonwood, and willow, and is of little value except for firewood and post material.

Antelope County was first settled in 1868. The county was organized by the State legislature in 1871, and its boundaries have remained unchanged. The population, which is all classed as rural, was 15,243 in 1920. Neligh is the county seat and largest town with a population 1,724.

The county has fair transportation facilities. It is crossed or entered by several railroads. Public highways follow most section lines except in the rougher and more sandy districts. All are dirt roads and are usually kept in good repair.

Omaha and Sioux City are the principal markets for the surplus agricultural products. Small quantities of wheat are ground into flour at Neligh and Oakdale.

The climate is favorable for the production of the common staple crops, such as corn, oats, rye, wheat, barley, and alfalfa. The mean annual temperature is 46.7° F., and the mean annual precipitation is 25.12 inches.

The present agriculture of the county consists of a combined system of grain growing and stock raising. The eroded loess plain section in the southeastern part is used chiefly for raising grain and alfalfa. The sandy upland belt, comprising the greater part of the county, and the rougher areas in the extreme northwestern part are used largely for cattle grazing and hay production. The more level land in these sections, however, is under cultivation, except where the soil is too sandy or stony for crop production. Approximately half of the area of the county is used for grain and tame-hay crops.

As a source of income the livestock industry of Antelope County holds a prominent place. It consists chiefly of the grazing and winter fattening of beef cattle and the raising of hogs.

The adaptation of certain soils to particular crops is observed to some extent by the farmers. There is not sufficient variation in the yields, however, to cause specialized farming in any part of the county, excepting in the Dunesand areas and in the extremely rough sections where cattle grazing is the chief industry.

Systematic crop rotation is not practiced, but most farmers change their crops with sufficient regularity to avoid the ill effects of continuous cultivation.

Farm labor is usually scarce during the busy season. Many farmers hire help by the year in order to insure against an inadequate supply at critical periods.

The size of the farms in Antelope County ranges from a few acres to over 1,000 acres. The Federal census reports the average size of the farms as 248.9 acres in 1920.

About 43 per cent of the farms are operated by tenants. The cash and share systems, and sometimes a combination of the two are used. Share rent is the most popular, and the tenant usually receives three-fifths of the grain. All seed, labor, and machinery is furnished by the tenant.

The selling price of the land depends upon the topography, drainage, improvements, character of the soil, and location with respect to markets. It ranges from $35 to $300 an acre.

Thirty soil types, one phase, Dunesand, and Riverwash, representing 14 soil series, are mapped in Antelope County. The upland soils comprise the Valentine, Gannett, Marshall, Holt, Scott, and Knox series, together with a miscellaneous material classed as Dunesand.

The more sandy soils, including the Valentine and Gannett series and Dunesand, cover the greater part of the county. Dunesand is not adapted to crop production on account of its loose nature and low content of organic matter. The Gannett soils are used largely for grazing and hay production. They are poorly drained and not suited to cultivation. The Valentine soils are used to a considerable extent for grain crops. Care must be taken, however, in their management in order to prevent excessive drifting when the native sod is destroyed.

The Marshall silt loam is the most important farming soil of the county. It occupies about one-sixth of the total area. This type is well suited to the production of corn, oats, rye, alfalfa, and garden vegetables. The lighter textured types of the Marshall series are also good farming soils, but are not as valuable as the silt loam type.

The Knox silt loam is a light-colored soil, being in reality an eroded phase of the Marshall silt loam. It is largely devoted to pasture, although well suited to the production of alfalfa and small fruits.

The Holt soils are developed rather extensively in the northwestern part of the county. The silt loam, fine sandy loam, and sandy loam are well adapted to grain crops except where erosion has thinned the surface soil or produced a steeply rolling and gullied topography. The gravelly sandy loam of this series is used only for pasture land.

The terrace soils include the Waukesha, O'Neill, Plainfield, and Sioux series.

The Waukesha soils include some of the highest priced land in the county. They are well drained, have a generally level topography, and are very strong and fertile. They occupy terrace or second-bottom positions along the larger streams.

The O'Neill fine sandy loam is of small extent in Antelope County. It is, however, well adapted to general farming, and produces well during normal years. The loamy fine sand type of this series is rather incoherent and low in organic matter, and care must be exercised in cultivating this soil to prevent blowing and consequent injury to grain crops.

The Plainfield sand differs little from the soils of the O'Neill series except in the lighter color and lower humus content of its surface soil. It is generally too sandy for cultivation and is used almost exclusively for pasture and hay land.

The soils of the Sioux series are very similar to those of the O'Neill series, differing mainly in the calcareous nature of the subsoil. They are for the most part fairly well drained.

The bottom-land soils of the county include the Wabash, Lamoure, Cass, and Sarpy series.

The Cass soils have dark-brown surface soils underlain by a loose, rather incoherent subsoil, which in places contains small gravel in the lower part. The Cass types as a whole are poorly drained, and are used largely for pasture and hay land. The better drained areas are very productive and well adapted to general farming.

The Sarpy sand differs from the Cass soils only in the lower organic matter content of the surface material and its consequently lighter color. It is used for pasture.

The Wabash soils are of a finer texture and heavier structure than those of the Cass series. They occur chiefly within the loessial upland of the county. The soils of the Wabash series are very rich and strong, and where well drained produce high yields of all crops.

The Lamoure soils differ from those of the Wabash series in the lighter color of their subsoils and in the calcareous nature of both the surface and subsoil. As a rule they are poorly drained and are suited only for pasture and hay land, except where artificial drainage has been established.

Riverwash occurs in a few small areas adjacent to the channel of the Elkhorn River. It consists of sand bars and sand flats lying a few feet above the normal flow of the streams.

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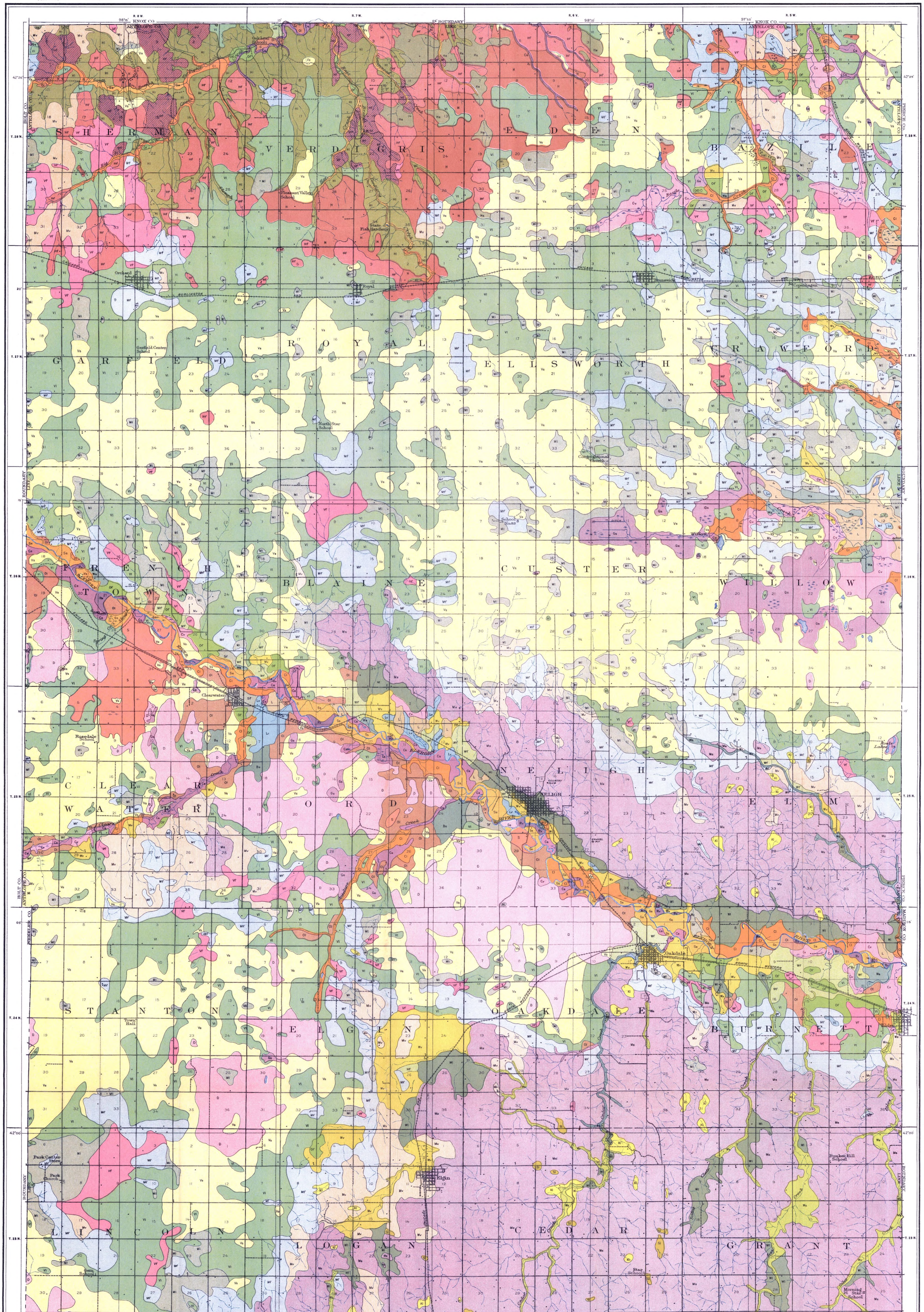
BUREAU OF SOILS
IN COOPERATION WITH THE
STATE SOIL SURVEY OF THE
UNIVERSITY OF NEBRASKA

# SOIL MAP

NEBRASKA
ANTELOPE COUNTY SHEET




## LEGEND

- Plainfield sand — Bs
- Marshall silt loam — Ms
- Cass loamy fine sand — Cs
- O'Neill loamy fine sand — Ol
- Cass fine sandy loam — Cl
- O'Neill fine sandy loam — Of
- Cass very fine sandy loam — Cv
- Sarpy sand — Ss
- Gannett loamy sand — Gs
- Scott silt loam — Sl
- Holt gravelly sandy loam — Hl
- Sioux loamy sand — S
- Holt sandy loam — H
- Sioux fine sandy loam — Sf
- Holt fine sandy loam — Hf
- Valentine sand — Vs
- Hilly phase — Hf
- Valentine loamy sand — Vl
- Holt silt loam — Hs
- Valentine fine sandy loam — Vf
- Knox silt loam — Kl
- Wabash very fine sandy loam — Wa
- Lamoure very fine sandy loam — Lv
- Wabash silt loam — Ws
- Lamoure silt loam — L
- Waukesha fine sandy loam — Wf
- Marshall loamy sand — Ml
- Waukesha very fine sandy loam — Wv
- Marshall fine sandy loam — Mf
- Waukesha silt loam — Wl
- Marshall very fine sandy loam — Mv
- Dunesand — D
- Riverwash — Rv

### CONVENTIONAL SIGNS

CULTURE
*(Printed in black)*

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
Secondary roads and trails
Railroads Steam and Electric
Bridges, Ferry
R.R. crossings, Tunnel
Ford, Dam
School or Church Cemeteries
Mine or Quarry Mine dumps Made land
Bluff, Escarpment, Rock outcrop and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines
Boundary lines
Boundary lines
U.S. township and section lines

RELIEF
*(Printed in brown or black)*

Contours Depression contours
Prominent Hills Mountain Peaks
Sand, Wash, and Sand dunes
Shore and Low-water line, Sandbar

DRAINAGE
*(Printed in blue)*

Streams
Lakes, Ponds, Intermittent lakes
Intermittent streams
Springs, Canals and Ditches, Flumes
Swamp Salt marshes
Submerged marsh Tidal flats

*The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.*

Soils surveyed by F. A. Hayes of the U. S. Department of Agriculture, in charge, and H. C. Mortlock, M. H. Layton, H. E. Weakley, and J. D. Westerman of the Nebraska Soil Survey

Scale 1 inch = 1 mile
1 ½ 0 1 2 3 4 Miles

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Field Operations
Bureau of Soils
1921